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# THE ANNALS
# OF THE BOLUS HERBARIUM

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South African College

# THE ANNALS
# OF THE
# BOLUS HERBARIUM

EDITED BY

H. H. W. PEARSON, Sc.D., F.L.S.

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## VOLUME I

With twenty-six plates and twelve text-figures

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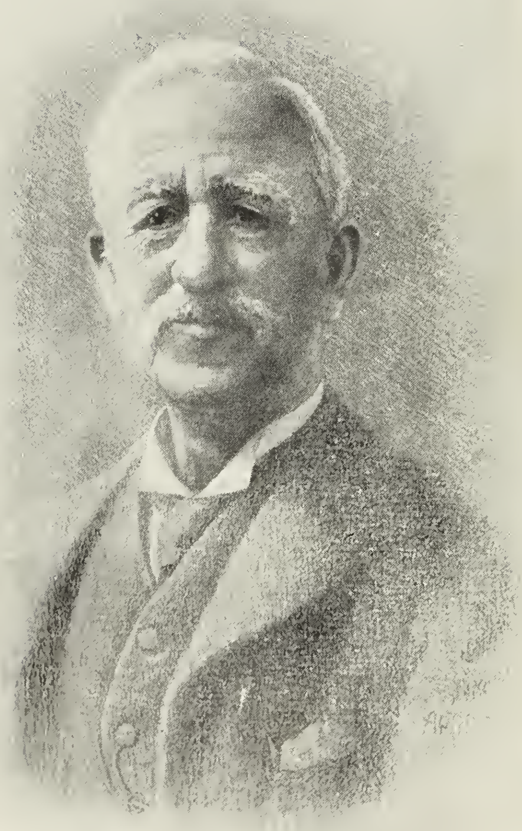

Yours Sincerely
Henry V [illegible]

South African College

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EDITED BY

H. H. W. PEARSON, Sc.D., F.L.S.

HARRY BOLUS PROFESSOR OF BOTANY IN THE SOUTH AFRICAN COLLEGE, CAPETOWN

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TO THE MEMORY OF

HARRY BOLUS

A SOUTH AFRICAN STUDENT OF BOTANY

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# FOREWORD

AN addition to the already large number of serial botanical publications demands an explanation if not an apology.

There is at present no South African journal which devotes itself entirely to botanical work. The field for botanical investigation in South Africa is very large and but sparsely occupied; the number of those directly or indirectly interested in its occupation is increasing. An eloquent testimony to the truth of this inference is furnished by the circumstances which last year culminated in the establishment of a National Botanic Garden. South Africa therefore offers both material and scope for a botanical journal.

The annals of the Bolus Herbarium will be mainly concerned with botanical work directly or indirectly inspired by Dr Bolus and with investigations conducted in or in connection with the Bolus Herbarium and contributing to our knowledge of the vegetation of South Africa—in particular of its taxonomy, ecology, economic and geographical botany.

Among the movements in which Dr Bolus was greatly interested must be included the extension and deepening of the teaching of Botany throughout the country. An attempt will therefore be made to include in these pages notes which it is hoped may prove of assistance to those engaged in teaching Botany in the schools. These will take the form of original articles on special subjects and of reviews of books and papers treating of botanical subjects.

.During the early stages of the development of the National Botanic Gardens, this journal will record such notices of the work carried on there as may be deemed to fall within its scope.

The *Annals of the Bolus Herbarium* must look for support to that section of the South African public which will desire the success of a scientific periodical indebted for its inception and establishment to the benefaction of a South African citizen to the science in whose service he spent many of the best years of his life.

H. H. W. P.

South African College,
Cape Town.
*January*, 1914.

# ON THE FLORA OF THE GREAT KARASBERG[1]

## I. INTRODUCTION

### BY H. H. W. PEARSON

THE pages immediately following will be occupied by a list of the flowering plants and ferns collected on the Great Karasberg by the Percy Sladen Memorial Expedition in the early summer of 1912–13.

This flora is of particular interest on account of the form and geographical position of the range on which it occurs. A detailed discussion of the phyto-geographical results of the expedition will be postponed until the determination of the collections has been completed. A few introductory remarks on the general features of the Karasberg, its position and climate, and on the localities named in the following list, may serve a useful purpose at this stage.

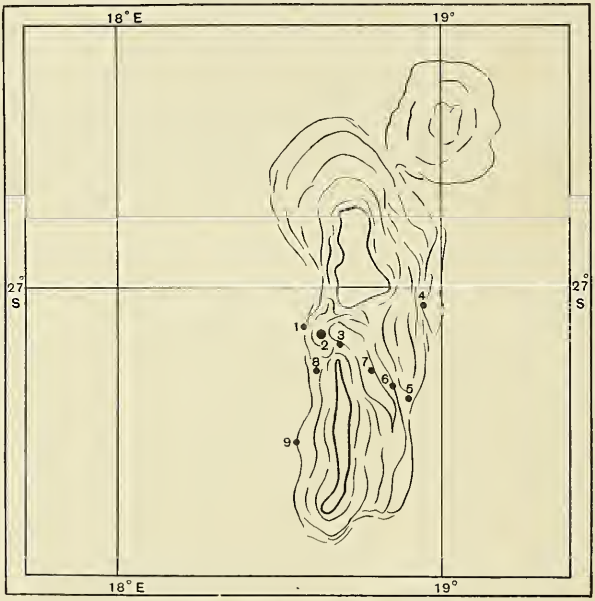
A traveller landing at any point on the South-west African coast and proceeding inland, rises gradually to a more or less rugged and broken mountain-belt beyond which he emerges upon the Central African plateau between 3000 and 4000 feet above the sea. This mountain-belt, representing the eroded edge of the central plateau, in different parts of its length, lies at distances from the coast varying from 10 to about 100 miles.

The coastal zone which separates this line of mountains from the sea enjoys a very low rainfall; throughout the greater part of its length it is a desert of a very pronounced type. Its flora includes a number of endemic genera as, e.g. Welwitschia and Acanthosicyos; for the most part, however, it consists of forms more or less closely related to those of various parts of the central plateau—the Karoo, the Upper Region and the Western Kalahari. With these are almost certainly a number of species descended from forms whose affinities are found in the north rather than in the east. A small element of this desert flora will probably be found to establish a slight degree of affinity with the Cape region. These desert species may, in general, be taken to represent the most resistant or most plastic forms of the floras of the neighbouring regions, which have been able to adapt themselves to the severe conditions which now prevail.

---

[1] *Percy Sladen Memorial Expeditions in South-West Africa, Report No.* 69. Assisted by grants from the Royal Society and the South African Government.

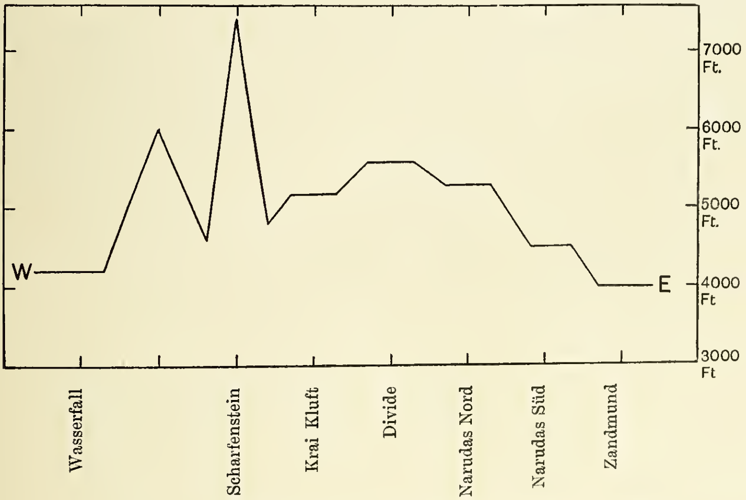
These facts invest the study of the vegetation of any mountain-range, situated on or near the western edge of the central plateau, with particular interest. Such a range will almost certainly enjoy a higher rainfall than the surrounding country. It may therefore be expected to harbour a richer collection of the forms proper to the region in which it stands as well as, especially on its higher slopes, species related to those of more distant localities. While these latter may or may not be held to throw light upon the past history of the flora now existing, it is hardly possible that the former will not afford some information as to the relationships obtaining between the vegetation of the regions meeting in or near the range. In a dry country the influence of a mountain-range so situated as to possess a more constant water-supply than the less elevated land in the vicinity must be widely felt—especially in such cases as that of South-West Africa, in which the rainfall is not only small but fitful. In many seasons the rainfall



Sketch map of the Great Karasberg.

both in the coast-belt and on the plateau is much below the average or may fail altogether[1]. If there occurs an uninterrupted succession of such seasons, it is reasonable to suppose that in many localities certain species—particularly annuals—may be completely exterminated, and might indeed disappear altogether if the less arid recesses of a suitably situated mountain-range did not provide a refuge in which they might persist until the conditions became again favourable for their extension beyond its limits.

The Great Karasberg range lies 350 km. from the coast and 150 km. due north from the Orange River at Houms Drift. It rises from the level plain of the Kalahari about 200 km. from its western edge, where the rapid fall to the coastal desert begins. Its extent is not easy to define, for to the north-east and south it merges into lower foothills which, particularly on the east, are of great extent. The higher levels of the range however stretch from south to north for a distance of 120 km. through which they maintain an approximately uniform breadth of 40 km. The localities 1, 8, 9 (see sketch map) are situated on the western boundary of this main part of the range; nos. 4 and 5 on the eastern boundary. The conspicuous feature of the range as above defined is a broad series of rolling plateaux which extend



Diagrammatic section through Great Karasberg Range from west to east, approximately to vertical scale.

---

[1] Pearson, 1906, *Phil. Trans.* B. vol. 198, pp. 267, 268.

from the eastern edge across two-thirds of its breadth. These plains are deeply cut by narrow river channels but, only in a few isolated localities, are they broken up into ridges and peaks. The main watershed lies between the localities 7 and 3, here coinciding with a line which approximately bisects the range from south to north. Near the western boundary the configuration is very different. Erosion has here been much greater than further east and the range is broken up in all directions by deep ravines whose sides are frequently almost vertical. Among the peaks and ridges, which here replace the plateaux of the east, are found the highest elevations of the range. These facts are indicated in the above diagram, which represents a section, roughly drawn to vertical scale, from Zandmund on the east to Wasserfall on the west.

The names and elevations of the stations visited by the expedition which are indicated in the sectional diagram and, by numbers, on the sketch map are as follows:

| | | | |
|---|---|---|---|
| No. 1. | Wasserfall | 4200 ft. | (Det. by Boiling Point Thermometer) |
| 2. | Scharfenstein | 7520 ft. | „ „ „ „ |
| 3. | Krai Kluft | 5200 ft. | „ „ „ „ |
| 4. | Baviaanspforte | 4800 ft. | „ Aneroid |
| 5. | Zandmund | 4000 ft. | „ „ |
| 6. | Narudas Süd[1] | 4500 ft. | „ „ |
| 7. | Narudas Nord | 5300 ft. | „ „ |
| 8. | Dassiefontein | | |
| 9. | Noachabeb | 5200 ft. | „ Boiling Point Thermometer |

The main watershed between localities 7 and 3 is crossed at 5600 ft.

The principal localities for which these stations served as centres were as follows:

1. Wasserfall.

(*a*) Conglomerate foothills and deep dry ravines (containing water pools at the end of January) trending upwards to Scharfenstein.

(*b*) An ancient and very broad river bed running west from Wasserfall, now thickly occupied by Euphorbia.

2. Scharfenstein.

Eastern slopes from 4800 ft. to summit.

---

[1] Formerly the werft of the Bondelzwart leader, Marengo.

3. Krai Kluft.

(*a*) Broad sandy valley, in places gravelly or thickly strewn with quartzite blocks, descending gently from Krai Kluft (5200 ft.) towards the south.

(*b*) Krai Kluft Ravine (about 5000 ft.) containing permanent water-pools.

(*c*) Sandstone and quartzite plateaux (6000 ft.) stretching north, east and south-east from Krai Kluft.

4. Baviaanspforte.

(*a*) Quartzite plateau.

(*b*) Broad stony river bed (4500 ft.) now dry save for a few distant pools.

5. Zandmund.

Junction of sandy plains of Kalahari with low foothills of Eastern Karasberg.

6. Narudas Süd.

(*a*) Sandy plains with isolated low hills to the east.

(*b*) Ravine of the Keiap River to the west.

(*c*) Extensive system of pools in bed of Keiap River (*Aponogeton Kraussiana*).

(*d*) Granite slopes capped by sandstone.

(*e*) Sandstone and quartzite plateaux at 5600 ft.

7. Narudas Nord.

Enormous pool of permanent water at the head of a long narrow ravine leading up from the middle Keiap.

8. Dassiefontein.

A broad sandy river bed falling westwards. Quite dry in January but bearing a dense growth of Acacias and Grasses on its banks.

9. Noachabeb.

A broad, mostly sandy river-bed falling westwards to an extensive series of red sand-dunes, trending north and south, which stretch almost uninterruptedly from the western foothills of the Great Karasberg to those on the east of the Little Karasberg.

In spite of the fact that the greater elevations are situated near the western limit of the range, the greater rainfall is deposited on the eastern side of the watershed. The records are not yet sufficient to afford a direct proof of this, but it is sufficiently indicated by the vegetation as well as by the testimony of those who know various parts of the range. It is said that the rain almost invariably comes from the N. E. It would appear then that the eastern plateaux are high and massive enough to cause so much deposition that the wind is comparatively dry by the time that it reaches the more westerly peaks. Consequently, the highest elevations, on which species of the greatest geographical interest might be expected to occur, are arid and their vegetation in the main karroid.

There is little available information as to the actual amount of rainfall at any of the stations visited. The following figures give the amounts registered at Narudas Süd in 1912. It is certain that a greater quantity fell in the same period at Narudas Nord and in the neighbourhood of the divide and that more westerly stations received smaller quantities.

*Narudas Süd*, 1912[1].

| | Rainfall in mm. | Rainy Days |
|---|---|---|
| January | 12·7 | 5 |
| February | 57·9 | 12 |
| March | 33·3 | 10 |
| April | 0 | 2 |
| May | 0 | 4 |
| June | 8·4 | 3 |
| July | 0 | 1 |
| August | 0 | 0 |
| September | 0 | 0 |
| October | 0 | 0 |
| November | 0 | 2 |
| December | 59·4[2] | 8 |
| Total | 171·7 | 47 |

Although this amount is small it is nevertheless almost certain that the Great Karasberg enjoys both a greater and a more constant rainfall than any other area in the southern part of Great Namaqualand[1]. Whether the small quantity of rain measured at Narudas Süd in June 1912 indicates that the range usually receives a small winter fall, it is impossible to say. However this may be, the testimony of the few who know these mountains from year's end to year's end, is to the effect that the vegetation is quite dormant from May until January. Apart from the question of winter rain or drought, this condition is likely to result from low temperatures. At Narudas Süd, the pools in the Keiap River are frequently frozen over and the ice so thick that skating is rendered impossible only by their small size. The bulbs shew above ground very soon after the first rains. The Grasses and Composites flower later; this year very many of the latter were only in bud at the end of January. It is said that the vegetation is "at its best" in April.

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[1] By the courtesy of Herr Feldwebel Scharf, O.C. at Narudas Süd military post.

[2] 36 mm. fell between 10 p.m. and 11 a.m. on December 28—29. The Keiap River which runs eastwards through Narudas Süd was in flood for 7 days following. Therefore more than 36 mm. must have fallen between Narudas Süd and the watershed.

The expedition arrived at Wasserfall on the western flanks of the range on December 8, 1912. Hardly any rain had then fallen and the veld was brown. *Boscia foetida*, Sch. and *Phaeoptilon spinosum*, Radlk. were in full flower but little else was yet even in bud. Leaving Wasserfall on Dec. 21, we crossed the range, arriving at Narudas Süd on Dec. 28, fourteen days after the first heavy rain. Here the bulbs were rapidly bursting into leaf and flower and other types of vegetation generally shewed signs of re-awakened activity. After crossing the range again in the opposite direction and by another route, we left it finally on January 26. By this time it is probable that most of the annuals and the geophytes were in flower; one or two months more would undoubtedly have increased the number of perennials in the collection and would have made it more truly representative of the flora as a whole. In fact the lists which follow must be regarded as indicating in the main the composition of the Spring Flora. And since one element of this spring vegetation—viz. the bulbous monocotyledons—is characteristic of the Kalahari rather than of Namaqualand proper, this collection taken by itself would indicate that the Kalahari element in the Karasberg flora bulks more largely than is actually the case. At the same time the Kalahari element is very marked not only in the bulbs but also in the Grasses, Acacias, Pedalineae, Cucurbitaceae and other groups. These are found in the main where the edaphic conditions resemble those of the Kalahari, i.e. where sand has accumulated. On the granite slopes, the flora is in the main that which is characteristic of the lower mountains of Namaqualand. *Aloe dichotoma* is abundant up to an elevation of 4700 ft. on the eastern side of the range and passes the 5000 ft. line on the western slopes. Above

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[1] In the summer of 1912–13 the drought remained almost unbroken throughout this area save only in the Great Karasberg.

6000 ft., on the steep and arid slopes of the western peaks, the flora presents many karroid features—particularly the great abundance of a few species of Mesembrianthemum. Even at the highest elevations there is no well-marked trace of the old Cape flora which is so prominent at similar elevations on the Kamiesberg and the Huilla Plateau. The uppermost precipitous slopes of Scharfenstein[1] support a rich growth of orange, green and slate-tinted crustaceous lichens whose colours, when illuminated by a low sun, are visible for many miles. The mists which make their existence possible do not appear to occur at all frequently below 6000 ft.

There is little available information regarding the geological structure of the Great Karasberg[2]. The main divide referred to above, and the parts of the range to the east of it, are composed of thick beds of sandstone, quartzites and probably other sedimentary rocks resting upon a granite base. At Narudas Süd the Keiap River and its tributaries have cut through the sandstone and into the granite whose upper level lies about 200 ft. above the river and the military station. To the west of the divide the sedimentary rocks soon disappear and the western parts of the range are composed almost entirely of primary rocks—granite, gneiss and schists. Occasionally however an isolated ridge on the extreme west of the range (as e.g. to the north of Dassiefontein) is still capped by sandstone.

Throughout the route followed by the expedition no settlers were met with save at Noachabeb. There is no cultivation except in small garden enclosures attached to the military stations. A few exotics were probably introduced by the military during the operations consequent upon the Bondelzwart rebellion. Away from Noachabeb and the military stations, the veld is practically untouched by domestic stock. Game of various kinds abounds in the recesses of the range.

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[1] Formerly known as Lord Hill.

[2] See Range, P., *Monatsberichte der Deutschen Geologischen Gesellschaft*, 1909, No. 3; *Trans. Geol. Soc. S.A.* vol. XIII. 1910.

# II. FLOWERING PLANTS AND FERNS COLLECTED ON THE GREAT KARASBERG BY THE PERCY SLADEN MEMORIAL EXPEDITION, 1912–1913[1]

By F. BOLUS, L. BOLUS and R. GLOVER

### RANUNCULACEAE.

Clematis Thunbergii, Steud. *Central Karasberg.* On rock in ravine, Krai Kluft, 7900.

### MENISPERMACEAE

Antizoma capensis (Linn. f.), Diels. var. pulverulenta, Harv. *Western and Central Karasberg.* Among rocks near water, common on lower slopes and in the ravine, Wasserfall Alt; Krai Kluft Ravine and high plateau above Krai Kluft, 8249, 7901, 8273, 8274.

Antizoma Miersiana, Harv. *Central Karasberg.* Krai Kluft Ravine and high plateau above Krai Kluft, 8189.

### CRUCIFERAE

Sisymbrium gariepinum, Burch. *Eastern Karasberg.* Footpaths in lower foothills and ravine, Narudas Süd; Outspan between Krai Kluft and Narudas Süd, 8175, 8086.

Lepidium linoides, Thunb. *Central Karasberg.* In rock crevices, summit of Scharfenstein, 7850.

Lepidium ruderale, Linn. *Central Karasberg.* River bed among stones, Krai Kluft, 8263.

Heliophila crithmifolia, Willd. *Western Karasberg.* Dry sandy river beds in granite between Dassiefontein and Noachabeb; broad dry sandy water course on high plateau between Krai Kluft and Wasserfall, 7868, 7869.

### CAPPARIDACEAE

Cleome hirta, Oliver. *Eastern Karasberg.* Lower foothills and granite slopes, Narudas Süd, 8164, 8332.

Cleome diandra, Burch. *Central Karasberg.* Ravines at base of Scharfenstein, 7894.

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[1] *Percy Sladen Memorial Expeditions in South-West Africa, Report No. 70.*

Gynandropsis pentaphylla, DC. *Eastern and Western Karasberg.* Narudas Süd and Wasserfall Alt Ravine, 7893.

Maerua arenicola, Gilg. *Western Karasberg.* Lower western slopes, Wasserfall camp, 8068.

Capparis punctata, Burch. *Western Karasberg.* High plateau between Wasserfall and Krai Kluft, 8268.

Boscia foetida, Schinz. *Western Karasberg.* Western slopes, Wasserfall, 8083.

### POLYGALACEAE

Polygala leptophylla, Burch. *Eastern, Central and Western Karasberg.* Sandstone slopes, Narudas Süd; ravine at base of Scharfenstein and steep rocky slopes, Krai Kluft Ravine; common on lower slopes, Wasserfall Alt, 8223, 8301, 7858, 7859, 7860.

### CARYOPHYLLACEAE

Dianthus micropetalus, E. Mey. *Central and Eastern Karasberg.* In crevices in sandstone in river bed near Krai Kluft and on summit of Scharfenstein; crevices in sandstone in river bed, Narudas Nord, 7854, 7856, 7855.

Silene clandestina, Jacq. *Central Karasberg.* In rock crevices on summit of Scharfenstein, 7857.

### PORTULACACEAE

Portulaca pilosa, Linn. *Eastern Karasberg.* Among stones in ravine of Keiap River, 7852.

Portulaca oleracea, Linn. *Central Karasberg.* Sandy ground, Krai Kluft, 7853.

Talinum caffrum, E. & Z. *Central and Western Karasberg.* Among stones on slopes above Krai Kluft Ravine; sandy ground on high plateau between Wasserfall and Krai Kluft, 8208, 8269.

Anacampseros namaquensis, Pearson & Stephens. *Western and Central Karasberg.* High plateau between Wasserfall and Krai Kluft, 8271.

Anacampseros lanigera, Burch. *Eastern and Western Karasberg.* Rocky ledges Narudas Süd; high plateau between Wasserfall Alt and Krai Kluft, 8170, 8264.

### MALVACEAE

Hibiscus Elliottiae, Harv. *Eastern and Central Karasberg.* Ravine, Narudas Süd and lower hill slopes east of Baviaanspforte; at Krai Kluft, 8126, 8157, 7871.

Abutilon indicum, Don. *Western Karasberg.* In sandy stream course 100 ft. above Wasserfall Alt Ravine, 7874.

Abutilon Sonneratianum, Sond. *Eastern Karasberg.* Eastern granite slopes, Narudas Süd, 8169.

Sida longipes, E. Mey. *Western Karasberg.* Sand at bottom of Wasserfall Alt Ravine, 7875.

### STERCULIACEAE

Melhania rupestris, Schinz. (ex descr.) *Eastern and Western Karasberg.* Clefts of rocks in river bed, Narudas Süd; sandstone slopes 300 ft. above Wasserfall Alt Ravine, 8216, 7870.

Melhania ovata, Spreng. *Western Karasberg.* Steep shale slopes of Wasserfall Alt Ravine, 7872.

Hermannia fruticulosa, K. Schum. *Western Karasberg.* By stony stream course on granite plateau between Dassiefontein and Noachabeb, 7905.

Hermannia gariepina, E. & Z. *Western Karasberg.* Sandy bed of river, Dassiefontein, 7906.

Hermannia coccocarpa, O. Ktze. *Central and Western Karasberg.* Sandy banks of dry river bed on high plateau between Krai Kluft and Wasserfall, 7907.

Hermannia Helianthemum, K. Schum. *Western, Central and Eastern Karasberg.* In sand in Wasserfall Alt Ravine; river bed below first outspan between Krai Kluft and Narudas Süd; rocky ledge Krai Kluft Ravine; stony river bank and among stones in Keiap River bed, 7908, 8102, 8288, 8315, 8310, 8309.

Hermannia comosa, Burch. *Eastern Karasberg.* Sandstone slopes, Narudas Süd, 8222.

Hermannia candidissima, Spreng. *Eastern Karasberg.* Foothills, Narudas Süd, 7909.

Hermannia abrotanoides, Schrad. *Eastern Karasberg.* Sandy flats Narudas Süd, 7910.

### TILIACEAE

Grewia cana, Sond. *Eastern and Central Karasberg.* Common in river bed, Baviaanspforte; in shallow water course on high plateau between Krai Kluft and Narudas Süd; in stony river bed between Baviaanspforte and Zandmund, 8156, 8099, 8153.

Grewia occidentalis, Linn. *Western Karasberg,* 7876.

### ZYGOPHYLLACEAE

Tribulus terrestris, Linn. *Eastern Karasberg.* Drying mud in river and on sandy plains, Narudas Süd, 8218, 7862.

Tribulus cristatus, Presl. *Western and Central Karasberg.* High plateau 5 miles south-east of Wasserfall; common on hills above Krai Kluft, 7863, 8197.

Zygophyllum tenue, Glover. *Central and Eastern Karasberg.* Sandy slopes near Krai Kluft; Narudas Süd, 7864, 7865.

Zygophyllum microphyllum, Linn. f. *Eastern Karasberg.* Narudas Süd, 7866.

Zygophyllum longicapsulare, Schinz. *Western Karasberg.* Common on veld east of Noachabeb, 8565.

Zygophyllum suffruticosum, Schinz. *Eastern, Central and Western Karasberg.* High plateau between Krai Kluft and Narudas Süd; granite plateau between Dassiefontein and Noachabeb, 8106, 8566.

### GERANIACEAE

Pelargonium carnosum, Ait. *Eastern Karasberg.* Sandstone slopes, Narudas Süd, 8300.

Pelargonium otaviense, R. Knuth. *Central and Western Karasberg.* In quartz vein on high plateau between Krai Kluft and Wasserfall, 7895.

Monsonia biflora, DC. *Eastern Karasberg.* Sandy plains, Narudas Süd, 7897.

Monsonia senegalensis, Guill. & Perr. *Western Karasberg.* Dry banks of gravel in Dassiefontein river bed and Wasserfall Alt Ravine, 7898.

Sarcocaulon Patersoni, DC. *Eastern, Central and Western Karasberg.* Common on granite and sandstone, ravine of Keiap River; stony places in plains at Krai Kluft; foothills Wasserfall, 7899, 8293, 8023.

Sarcocaulon Burmanni, DC. *Eastern and Central Karasberg.* Hills east of Baviaanspforte; granite slopes opposite Krai Kluft, 8155, 8024.

### RUTACEAE

Thamnosma africanum, Engler. *Western Karasberg.* Among rocks on steep sides of Wasserfall Alt Ravine, 7851.

### RHAMNACEAE

Zizyphus mucronata, Willd. *Western Karasberg.* Common in river beds, Wasserfall Alt Ravine, 7903.

## SAPINDACEAE

Pappea capensis, E. & Z. *Eastern Karasberg.* Narudas Süd, 8180.

Aitonia capensis, Linn. f. var. microphyllum, Schinz. *Central Karasberg.* Common on summit of first ridge, Narudas Süd, 8184.

Melianthus comosus, Vahl. *Central Karasberg.* Ravine 100 ft. below summit of Scharfenstein, 7902.

## ANACARDIACEAE

Rhus Burchellii, Sond. *Central Karasberg.* Near top of ravine, Krai Kluft, 8203.

Heeria hereroensis, Schinz. *Eastern, Central and Western Karasberg.* River bed, Narudas Süd, 8235; Krai Kluft Ravine, 8275; western slopes, Wasserfall camp, 8069.

## LEGUMINOSAE

Indigofera transvaalensis, Bak. f. *Eastern Karasberg.* Keiap River bed, Narudas Süd, 7877.

Indigofera psammotropha, Bolus. *Western Karasberg.* Sandy river bed on granite between Dassiefontein and Noachabeb, 7879.

Indigofera auricoma, E. Mey. *Eastern, Central and Western Karasberg.* Sandstone slopes, Narudas Süd; stony slopes south-west of Krai Kluft; stony and sandy localities on granite plateau between Dassiefontein and Noachabeb, 7881, 8217, 7882.

Indigofera parviflora, Heyne. *Western Karasberg.* Sandy bed of water course above Wasserfall Alt Ravine, 7883.

Indigofera affinis, Harv. *Western and Central Karasberg.* High plateau 5 miles south-east of Wasserfall; stony slopes south-west of Krai Kluft, 7884, 7880.

Indigofera cryptantha, Benth. *Western and Eastern Karasberg.* In sand near water, Wasserfall Alt; sand in river bed, Narudas Süd, 8244, 8314.

Indigofera patens, E. & Z. *Central and Western Karasberg.* Among rocks in ravine, Krai Kluft; granite plateau between Dassiefontein and Noachabeb, 8209, 8283, 8289, 7885.

Indigofera sordida, Benth. *Central Karasberg.* In sandy river bed, Krai Kluft, 7886, 8195.

Indigofera heterotricha, DC. *Eastern Karasberg.* Lower hill slopes, Narudas Süd, 8163.

Indigofera spinosa, Forsk. *Eastern Karasberg.* Sandy plains north-east of Narudas Süd, 8149.

Psoralea obtusifolia, DC. *Central Karasberg.* River bed, Krai Kluft Ravine, 8280.

Melolobium karasbergense, L. Bolus, n. sp. *M. adenodei proxime accedit sed habitu graciliore, floribus paucioribus minoribus, bracteis minutis, calycis tubo multo brevioribus, differt.*

Fruticulus inermis gracilis erectus, e basi ramosus, ad 40 cm. altus; rami ramulique adscendentes glandulosi, glandulis stipitatis, virides, 0·1—0·4 cm. diam.; folia erecto-patentia, fere glabra, subviscidula, laete viridia, foliolis lineari-oblongis vel rarius obovatis, basi cuneatis, 0·8—1·2 cm. longis, stipulis semi-cordatis acuminatis, saepius inaequaliter 2lobis vel 2partitis, 0·2—0·4 cm. longis; pedunculi laxissime pauciflori (saepius 2—3fl.), 0·6—0·8 cm. longi, parte florifero 1·5—2·5 cm. longo, floribus patentibus, 0·6—0·7 cm. longis; calyx glandulosus, 0·6 cm. longus; vexilli lamina ovato-oblonga; carina obtusa; legumen immaturum strictum, inter 2—4 semines constrictum, ad 1·3 cm. longum.

*Western and Central Karasberg.* Sandy dry river bed in high plain between Krai Kluft and Wasserfall.

An unarmed slender erect shrublet, branched from the base, up to 40 cm. high; branches and branchlets ascending glandular with stipitate glands, green, 0·1—0·4 cm. in diam.; leaves erect-spreading, almost glabrous, somewhat viscidulous, bright green, the leaflets linear-oblong or more rarely obovate, cuneate at base, 0·8—1·2 cm. long, the stipules semi-cordate acuminate, usually unequally 2lobed or 2partite, 0·2—0·4 cm. long; peduncles very laxly few-flowered (usually 2—3fl.), 0·6—0·8 cm. long, the flower-bearing portion 1·5—2·5 cm. long, the flowers spreading, 0·6—0·7 cm. long; calyx glandular, 0·6 cm. long; lamina of the vexillum ovate-oblong; carina obtuse; immature legume straight, constricted between the 2—4 seeds, up to 1·3 cm. long.

Nearest *M. adenodes* but differs in the more slender habit, fewer and smaller flowers, and minute bracts much smaller than the calyx tube.

Hoffmanseggia Pearsonii, Phillips. *Western and Eastern Karasberg.* Sandy bank of dry shallow water course on high plateau 5 miles south-east of Wasserfall; stony slopes west of Baviaanspforte and Narudas Süd, 7888, 8160, 8230.

Dolichos linearis, E. Mey. *Eastern Karasberg.* High plateau between Krai Kluft and Narudas Süd, 8221, 8105.

Lessertia falciformis, DC. *Central Karasberg.* Scharfenstein, 7889.

Lessertia benguelensis, Baker. *Western Karasberg.* Dry sandy stream course on granite plateau between Dassiefontein and Noachabeb, 7890.

Tephrosia damarensis, Engl. *Eastern Karasberg.* Ravine of Keiap River among stones, 7891.

Tephrosia sphaerosperma, Baker. *Western Karasberg.* Sand-dunes between Noachabeb and Gründoorn, 7892.

Sylitra biflora, E. Mey. *Eastern Karasberg.* Sandy plains Narudas Süd, 8327.

Rhynchosia Totta, DC. var. grandiflora, L. Bolus. *Central Karasberg.* River bed, Krai Kluft, 8286.

Acacia caffra, Willd. *Eastern, Western and Central Karasberg.* River bed, Narudas Süd; in shallow water course, high plateau between Wasserfall and Krai Kluft; rocky banks of ravines Wasserfall, 8237, 8267, 8072.

Acacia detinens, Burch. *Eastern Karasberg.* Sandy plains north-east of Narudas Süd; stony plains south of Keiap River, 8145, 8316.

### Rosaceae.

Grielum Marlothii, Engl. *Western Karasberg.* Dry sandy slopes between Wasserfall Alt and Dassiefontein, 7911.

### Saxifragaceae

Vahlia capensis, Thunb. *Eastern Karasberg.* Sandy plains, Narudas Süd, 8538.

### Crassulaceae

Crassula lycopodioides, Lam. *Central Karasberg.* On rocks on slopes, Krai Kluft, 8537.

Cotyledon trigyna, Burchell. *Central Karasberg.* Summit of hill above outspan, facing east, Krai Kluft, 8212.

### Lythraceae

Nesaea sagittifolia, Koehne. *Western Karasberg.* Among loose stones at bottom of Wasserfall Alt Ravine, 8536.

### Onagrariaceae

Montinia acris, Linn. f. *Central Karasberg.* Krai Kluft Ravine, 8281.

### Passifloraceae

ca Modecca Paschanthus, Harv. *Eastern Karasberg.* Middle slopes, Narudas Süd, 8166.

## CUCURBITACEAE

Trochomeria debilis, Hook. f. ♀ & ♂. *Eastern Karasberg.* On rocks on summit of first ridge, Narudas Süd, 8183, 8185, 8526.

Cucumis Figarci, Delile. *Eastern and Central Karasberg.* Among sandstone rocks near summit, Narudas Süd; Scharfenstein, 8177, 8529.

Cucumis Melo, Linn. *Central Karasberg.* Among sandstone boulders upper Krai Kluft Ravine, 8528.

Cucumis africana, Linn. f. *Eastern Karasberg.* Sand in river bed at Narudas Süd, 8219.

Corallocarpus Welwitschii, Hook. f. *Central and Eastern Karasberg.* Among stones on slopes, Krai Kluft Ravine, 8276; climbing on bushes, Krai Kluft, 8115, 8112; lower slopes, Narudas Süd, 8522.

Kedrostis sp. ♂ & ♀. *Eastern Karasberg.* Sandstone plateau Narudas Süd, 8523, 8524.

Kedrostis sp. ♂. *Eastern and Central Karasberg.* Among rocks on camel path between Narudas Süd and Krai Kluft, 8525.

Kedrostis sp. ♂. *Central Karasberg.* Among rocks, Krai Kluft, 8190.

Kedrostis sp. ♂. *Central Karasberg.* High plateau between Krai Kluft, 8098.

Kedrostis sp. ♂. *Central Karasberg.* Scrambling among rocks, hill above outspan, Krai Kluft, 8211.

Kedrostis punctulata, Cogn. *Central and Eastern Karasberg.* Second outspan between Krai Kluft and Narudas Süd, 8097.

Coccinea quinqueloba, Schrad? *Eastern and Central Karasberg.* Rocks above camel path and sandstone slopes, Narudas Süd; lower slopes of Scharfenstein and Krai Kluft, 8531, 8193.

Coccinea Adoensis, Cogn.? ♀ & ♂. *Eastern and Central Karasberg.* Rocks above camel path and sandstone slopes, Narudas Süd; lower slopes of Scharfenstein and Krai Kluft, 8532, 8533.

Coccinea indica, Wight & Arn. *Central Karasberg.* Lower slopes of Scharfenstein and Krai Kluft, 8530.

## FICOIDEAE[1]

Mesembrianthemum sp. *Central Karasberg.* Lower stony slopes at Krai Kluft, 8116.

Mesembrianthemum uncinellum, Haw. *Central Karasberg.* Summit of Scharfenstein, 8567.

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[1] Named from dried specimens.

Mesembrianthemum unidens, Haw. *Central Karasberg.* Stony plains south-west of Krai Kluft, and river bed in sandstone plateau between Narudas Nord and Krai Kluft, 8109.

Mesembrianthemum karasbergense, L. Bolus, n. sp. *M. verruculato affine, sed foliis brevioribus, apicem versus dilatatis, floribus solitariis differt.*

Fruticulus erectus rigidus glaber ramosus, ad 30 cm. altus; rami superne foliati, inferne foliorum delapsorum cicatricibus inconspicue notati, vel ramulis per totam longitudinem foliosis, ad 20 cm. longi, saepius 7—9 cm. longi, 0·4—0·6 cm. diam.; folia saepius erecto-incurva, rarius adscendentia vel patentia, basi connata, turgide 3quetra, apicem obliquum vel rotundatum versus sensim dilatata, minute punctulata, internodios excedentia, 1·5—2·5 cm. longa, 0·8—0·9 cm. diam.; flores terminales solitarii pedunculati, pedunculis medio bibracteolatis, 1—2 cm. longis, 5meri, 1·5—2 cm. diam.; sepala inter se aequilonga, oblongo-lanceolata obtusa, 0·8—1 cm. longa; petala (staminodia) aurea, sepalis longiora; stamina pluri-seriata; glandulae contiguae semi-lunatae; styli erecti lineari-filiformes setaceo-acuminati, 0·7—0·9 cm. longi.

*Central Karasberg.* Plains west of Krai Kluft, 8270.

*Forma*—petalis albis, vel dilute rosaceo-suffusis.

*Central Karasberg.* Stony plains south-west of Krai Kluft, 8587.

An erect rigid glabrous branched shrublet, attaining 30 cm. in height; branches leafy above, inconspicuously marked by the scars of fallen leaves below, or the branchlets densely leafy throughout, up to 20 cm. long, usually 7—9 cm. long; 0·4—0·6 cm. in diam.; leaves usually erect-incurved, more rarely ascending or spreading; connate at the base, turgidly 3quetrous, gradually widened towards the oblique or rounded apex, minutely punctulate, exceeding the internodes, 1·5—2·5 cm. long, 0·8—0·9 cm. diam.; flowers terminal, solitary pedunculate, the peduncles bi-bracteolate in the middle, 1—2 cm. long, 5merous, 1·5—2 cm. diam.; sepals equal in length, oblong-lanceolate obtuse, 0·8—1 cm. long; petals (staminodes) golden yellow, longer than the sepals; stamens in several series; glands contiguous semi-lunate; styles erect linear-filiform, setaceously acuminate, 0·7—0·9 cm. long.

*Form*—petals white or suffused with pale pink.

Nearest *M. verruculatum*, but differs in having the leaves shorter and gradually dilated towards the oblique or rounded apex, and the flowers solitary.

Mesembrianthemum noctiflorum, L. *Eastern Karasberg.* Sandy plains north-east of Narudas Süd, 8147.

Mesembrianthemum granulicaule, Haw. *Eastern, Central and Western Karasberg.* Among granite rocks, Keiap Ravine; sandy ground, Krai Kluft; sandy plains between Gründoorn and Nakeis, 8568, 8585, 8586.

Mesembrianthemum spinosum, L. *Eastern and Central Karasberg.* Stony ground on plains, Narudas Süd; lower slopes Krai Kluft, 8108, 8588.

Mesembrianthemum ciliatum, Thunb. Stony ground between Klein Karas and Nakeis, 8067.

Mesembrianthemum tuberosum, L. *Eastern and Central Karasberg.* Granite slopes, Narudas Süd; sandstone plateau on summit of Long Hill east of Krai Kluft, 8569, 8589.

Mesembrianthemum floribundum, Haw. var. *β*, erectius. *Eastern and Central Karasberg.* Granite foothills Narudas Süd; slopes south-west of Krai Kluft, 8570, 8590.

Mesembrianthemum barbatum, L. *Central Karasberg.* Middle slopes Scharfenstein, 8571.

Mesembrianthemum geniculiflorum, L. *Eastern and Central Karasberg.* On granite, Keiap Ravine; between Krai Kluft and Narudas Süd; slopes west of Krai Kluft, 8093, 8591.

Tetragonia spicata, L. f. var. *a*, latifolia. *Eastern Karasberg.* Narudas Süd. In shade on mud bank in Keiap River, 8672.

Aizoon Burchellii, N. E. Br. *Central and Western Karasberg.* Summit of Scharfenstein; Wasserfall Ravine, 8592, 8253.

Galenia papulosa, Sond. *Central Karasberg.* Sandstone plateau on summit of Long Hill east of Krai Kluft, 8574.

Galenia africana, L. *Central Karasberg.* Slopes at foot of Scharfenstein, 8575.

Trianthema crystallina, Vahl. *Eastern Karasberg.* Dry sandy places near river, Narudas Süd, 8581.

Orygia decumbens, Forsk. *Western Karasberg.* On loose steep shale slopes, Wasserfall Alt Ravine, 8582.

Mollugo Cerviana, Seringe. *Eastern Karasberg.* Granite hill and sandy plains, Narudas Süd, 8578.

Pharnaceum reflexum, E. & Z. *Eastern and Central Karasberg.* Narudas Süd; banks of the Keiap R.; at the edge of an out-crop of granite on plains near Krai Kluft, 8577, 8593.

Pharnaceum verrucosum, E. & Z. *Eastern Karasberg.* In sandy places, Narudas Süd, 8337.

Gisekia pharnaceoides, L. *Central Karasberg.* Sandy slopes, near Krai Kluft, 8579.

Gisekia Miltus, Fenzl. *Eastern Karasberg.* Sandy places, Narudas Süd, 8580.

Limeum viscosum, Fenzl. *Eastern and Western Karasberg.* Sandy plains, Narudas Süd; dry sandy slopes between Wasserfall Alt and Dassiefontein; Wasserfall Alt Ravine, 8583, 8594, 8595.

Limeum viscosum, Fenzl. var. perenne, L. Bolus. *Eastern and Central Karasberg.* Ravine, Narudas Süd; camel path between Narudas Süd and Krai Kluft, 8129, 8196.

Limeum aethiopicum, Burm. *Central Karasberg.* Sandy slope near Krai Kluft, 8584. Common all over the Karasberg.

### UMBELLIFERAE

Pituranthos aphylla, O. Kntze. *Western Karasberg.* Dry sandy river bed on granite plateau between Dassiefontein and Noachabeb, 8535.

### RUBIACEAE.

Anthospermum rigidum, E. & Z. *Central Karasberg.* Scharfenstein, 8553.

Oldenlandia thymifolia, O. Kntze. *Western Karasberg.* In sand near water hole, Wasserfall Alt, 8247.

Oldenlandia Heynii, G. Don. *Eastern Karasberg.* Narudas Süd, 8236.

Oldenlandia caffra, E. & Z. *Eastern Karasberg.* Among stones in Keiap River bed, 8554.

(*To be continued*)

# NOVITATES AFRICANÆ

PILLANSIA, *L. Bolus.* nov. gen. [Irideae—Ixieae]; ad *Watsoniam* proxime accedit sed floribus in cymosam paniculam dispositis, perianthii tubo perbreve, staminibus equilateralibus, multis cormis persistentibus differt.

Perianthium regulare gamophyllum, segmentis tubo duplo longioribus; stamines equilaterales, parum infra medium tubi inserti, filamentis inter se liberis; styli rami bifidi, staminibus alternantes, ovulis numerosis.

Species 1, Templemanni.

P. TEMPLEMANNI, *L. Bolus.* Herba perennis glaberrima, axillis saepius intus mucosis, 0·9—1·20 met. alta; cormi persistentes, ad 20 superpositi, depresse globosi, vetustiores mudi striati, juniores fibrosis tunicis dense tecti, c$^{a}$ 2·5 cm. diam.; caulis ex axilla folii persistentis anni prioris exoriens, subfistulosus, inferne compressus, angustissime alatus, superne teretis exalatus, basi 3—4 vaginis foliaceis ad 20 cm. longis vestitus, folio evoluto solitario erecto rigido, laxe contorto, lineari, apicem versus gradatim attenuato, crebre inconspicueque nervato, ad 1·20 met. longo, 1 cm. lato, sursum 2—3 vaginis distantibus foliaceis, sensim in bracteas chartaceas abeuntibus, ornatus; flores speciosi solitarii, terminales in ramis primariis, secundariis, tertiariis et quartanis, cymosam paniculam laxiusculam, 25—40 cm. longam, ramulis adscendentibus vel suberectis, 4—9 cm. longis, formantes; spathae basi ramulorum parvae subsquamiformes, eis sub floribus dimidio inferiore herbaceis, margine chartaceis, 0·8—1 cm. longis, exterioribus ovato-triangularibus acutis, interioribus latioribus, apicem versus ampliato-rotundatis; perianthii tubus cylindricus, sursum parum dilatatus, 0·7 cm. longus, segmentis inter se similibus, ovalibus obtusis, sub apice apiculatis 2·5 cm. longis; stamines 2·4 cm. longi, antheris linearibus, basi sagittatis, 0·8 cm. longis; stylus filiformis, ramulis truncatis. *Tritonia Templemanni, Baker, Handb. Irid.* 193. *Flor. Cap.* VI. 124.

CAPE COLONY: *South-Western Region*; Caledon Div., on ridges on western side of Palmiet River valley, fl. Nov., *N. S. Pillans,* 2242.

Perianth regular gamophyllous, the segments twice as long as the tube; stamens equilateral, inserted a little below the middle of the tube, the

filaments free from each other; style-branches bifid, alternating with the stamens, ovules numerous.

A perennial glabrous herb, usually mucilaginous within the axils, 0·9—1·20 met. high; corms persistent, so many as 20 superposed; depressed-globose, the older ones bare striate, the younger ones densely covered with fibrous tunics, 2·5 cm. diam.; stem arising from the bud of the persistent green leaf of the previous year, somewhat fistular, compressed below and very narrowly winged, terete above and wingless, bearing 3—4 foliaceous sheaths up to 20 cm. long at the base, the fully developed leaf solitary erect rigid, laxly twisted, linear, gradually tapering towards the apex, closely and inconspicuously nerved, attaining a length of 1·20 met., 1 cm. broad, followed by 2—3 distant foliaceous sheaths gradually passing off into the chartaceous bracts; flowers handsome solitary, terminal on the primary, secondary, tertiary and quaternary branches, forming a somewhat lax cymose panicle 25—40 cm. in length, with ascending or suberect branches, 4—9 cm. long; spathes at the base of the branches small somewhat scale-like, those immediately below the flowers herbaceous in the lower half, chartaceous round the margin, 0·8—1 cm. long, the exterior ones ovate-triangular acute, the interior broader, widened and rounded towards the apex; perianth tube cylindrical, a little dilated upwards, 0·7 cm. long, segments alike, oval obtuse, apiculate below the apex 2·5 cm. long; stamens 2·4 cm. long; anthers linear, sagittate at base 0·8 cm. long; style filiform, the branches truncate.

Most nearly allied to *Watsonia* from which it differs in having the flowers arranged in a cymose panicle, the tube of the perianth very short, the stamens equilateral, and the large number of persistent corms.

A specimen of this plant in the Kew Herbarium sent by Prof. MacOwan in 1888, was named by Mr Baker Tritonia Templemanni; but the presence of bifid style-branches and equilateral stamens exclude it from the genus Tritonia.

I have much pleasure in naming this plant after Mr N. S. Pillans.

(*To be continued*)

# KEY TO THE FLORA OF THE CAPE PENINSULA

By F. and L. BOLUS

The following artificial key for determining the Orders of the group Spermaphyta (to be followed in subsequent numbers of this publication by keys to the genera and species) of Cape Peninsula plants has been written in order to amplify and increase the usefulness of Bolus and Dod's *List of Flowering Plants and Ferns.* In order to make it quite practicable for use in the field as far as possible no characters have been chosen which are not obvious with the aid of an ordinary hand lens. The main divisions of the Vegetable Kingdom may be seen at a glance from the following table.

1. Spermaphyta—Plant-body (Sporophyte) normally consisting of root, stem and leaf. Reproduction by seeds.
   - (*a*) Angiospermae, with carpels so enfolded or arranged as to form an ovary in which the ovules are borne—endosperm usually formed after fertilisation.
     - Dicotyledones, embryo with 2 lateral cotyledons; stem with open vascular bundles usually in a single ring; leaf netted-veined.
     - Monocotyledones, embryo with 1 terminal cotyledon; stem with closed vascular bundles, "scattered" as seen in cross-section, leaves parallel-veined.
   - (*b*) Gymnospermae, seeds not enclosed in an ovary; endosperm formed before fertilisation.

2. Pteridophyta—The sporophyte, the more prominent of the two independent generations, normally consisting of root, stem and leaf. Reproduction by free spores.
   - (*a*) Lycopodiales—The Club mosses.
   - (*b*) Ophioglossales—The Adder's tongue Ferns.
   - (*c*) Filicales—The Ferns.

3. Bryophyta—The sporophyte dependent upon the gametophyte. The gametophyte a thallus not differentiated into root, stem and leaf.
   - (*a*) Hepaticae—Liverworts.
   - (*b*) Musci—Mosses.

4. Thallophyta—Sporophyte absent or obscure. Gametophyte usually a simple undifferentiated thallus.
   - (*a*) Myxomycetes—Slime fungi.
   - (*b*) Cyanophyceae—Blue-green algae.
   - (*c*) Schizomycetes—Bacteria.
   - (*d*) Algae.
   - (*e*) Fungi.

## I. SPERMAPHYTA (Phanerogams or flowering plants)

I. Angiospermae (ovules enclosed in an ovary).
  A. Dicotyledones (leaves netted-veined; whorls of the perianth not composed of 3 members).
    a. Both whorls of the perianth present.
      1. Petals quite free to the base.
        Stamens more than 10.
          Ovary inferior.
            Gynaeceum syncarpous.
              Water or marsh plants with floating leaves. *Nymphaeaceae.*
              Habit not as above. *Ficoideae.*
            Gynaeceum apocarpous (carpels enclosed in a cup-like receptacle). *Rosaceae.*
          Ovary superior.
            Leaves stipulate.
              Stipules pungent; carpels 5 adhering to a beak-like receptacle. *Geraniaceae.*
              Stipules not pungent; carpels not as above.
                Gynaeceum apocarpous (carpels on a conical receptacle). *Rosaceae.*
                Gynaeceum syncarpous.
                  Calyx imbricate in bud; flowers insignificant; stamens 10—12.
                    Flowers unisexual. *Euphorbiaceae.*

Flowers hermaphrodite; sepals 2. *Portulaceae.*

Calyx valvate in bud; flowers usually handsome; stamens numerous.

Stamens distinct; anthers 2-celled. *Tiliaceae.*

Stamens monadelphous; anthers 1-celled. *Malvaceae.*

Leaves exstipulate.

Gynaeceum apocarpous. *Ranunculaceae.*

Gynaeceum syncarpous.

Sepals 2. *Portulaceae*

Sepals more than 2.

Flowers solitary, large, water or marsh plants. *Nymphaeaceae.*

Flowers not as above.

Petals irregular, cut; leaves herbaceous. *Resedaceae.*

Petals regular; leaves succulent. *Ficoideae.*

Stamens 10 or fewer.

Ovary inferior.

Gynaeceum apocarpous (carpels enclosed in a cup-like receptacle). *Rosaceae.*

Gynaeceum syncarpous.

Leaves stipulate.

Leaves entire. *Rhamneae.*

Leaves multifid. *Rosaceae.*

Leaves exstipulate.

Placentas parietal; plants with tendrils. *Cucurbitaceae.*

Placentas axile, or ovules solitary; plants without tendrils.

Flowers in umbels, or the racemes in umbels (in Hydrocotyle the umbel is imperfect).

Styles 2; leaves not digitately compound. *Umbelliferae.*

Styles 3 or 4; leaves digitately compound. *Araliaceae.*

- Flowers not in umbels.
  - Ovary 1-celled; branch parasites. *Loranthaceae.*
  - Ovary more than 1-celled; not parasitic.
    - Flowers not tetramerous (or if tetramerous flowers densely capitate).
      - Herbaceous, almost stemless; leaves 6—12 in. in diameter. *Halorageae.*
      - Shrubby; leaves narrower usually heath-like.
        - Leaves entire; flowers small.
          - Calyx hairy outside (or if glabrous as in Noltea then leaves not heath-like); Stamens opposite petals. *Rhamneae.*
          - Calyx glabrous outside; stamens alternate with petals. *Bruniaceae.*
        - Leaves multifid; flowers large, yellow. *Rosaceae.*
    - Flowers tetramerous, not capitate.
      - Trees; leaves glabrous and glossy above, rusty tomentose beneath. *Cornaceae.*
      - Herbs or shrubs.
        - Creeping; ovary 1-celled. *Halorageae.*
        - Not creeping; ovary more than 1-celled, or if imperfectly 1-celled then dioecious. *Onagrarieae.*

- Ovary superior.
  - Leaves stipulate.
    - Gynaeceum of 1 carpel. *Leguminosae.*
    - Gynaeceum of more than 1 carpel, syncarpous.
      - Corolla regular.
        - Leaves with circinate vernation and furnished with sticky glandular hairs. *Droseraceae.*
        - Leaves not as above.

Styles distinct to the base.
  Calyx in a broken whorl (i.e. some of the sepals appearing to be within the others), much imbricated. *Elatineae.*
  Calyx in a complete whorl, little imbricated.
    Stipules membranous; ovary 1-celled.
      Stipules ochreate; ovary 1-ovuled. *Polygonaceae.*
      Stipules not ochreate; ovary ∞-ovuled. *Caryophyllaceae.*
    Stipules not membranous; ovary more than 1-celled.
      Flowers unisexual; leaves simple. *Euphorbiaceae.*
      Flowers hermaphrodite; leaves compound; a tree. *Saxifrageae.*
Styles not distinct to the base.
  Gynaeceum of 5 1-ovuled carpels adhering to a beak-like receptacle; stamens monadelphous. *Geraniaceae.*
  Gynaeceum not as above.
    Calyx of 2 sepals. *Portulaceae.*
    Calyx of more than 2 sepals.
      Leaves compound. *Zygophylleae.*
      Leaves simple.
        Petals twisted in the bud (i.e. contorted aestivation); pubescence stellate; stamens slightly connate at base. *Sterculiaceae.*
        Petals valvate in the bud; pubescence not stellate; stamens free.
          Scrambling or twining with tendrils; leaves broader than long. *Ampelideae.*
          Erect, or if scrambling then with thorns; leaves not broader than long. *Rhamneae.*

Corolla irregular.

Leaves compound. *Sapindaceae.*

Leaves simple (or if compound then inflorescence not a crowded raceme a foot or more long).

Stamens equal to the petals in number; posterior petal spurred. *Violarieae.*

Stamens twice or thrice as many as the petals. *Geraniaceae.*

Leaves exstipulate.

Gynaeceum of 1 carpel with or without 1—2 aborted carpels.

Fruit leguminous; corolla papilionaceous. *Leguminosae.*

Fruit and corolla not as above; petals soon deciduous. *Anacardiaceae.*

Gynaeceum of more than 1 carpel.

Gynaeceum more or less apocarpous.

Carpels each with an hypogynous scale. *Crassulaceae.*

Carpels without hypogynous scales.

Flowers hermaphrodite; carpels 2, hemispherical, united by their flat side; sepals herbaceous with membranous margins. *Ficoideae.*

Flowers dioecious.

Leaves compound; upright shrubs; petals more than 1. *Anacardiaceae.*

Leaves simple; upper branches twining; petal 1. *Menispermaceae.*

Gynaeceum syncarpous.

Cells of the ovary 1-ovuled.

Trees; inflorescence paniculate; leaves dimidiate. *Olacineae.*

Herbs or shrubs; inflorescence not paniculate.

Flowers unisexual, dioecious. *Euphorbiaceae.*

Flowers hermaphrodite.

Stamens tetradynamous; corolla cruciform. *Cruciferae.*

Stamens and corolla not as above.

Style lateral; ovary 1-celled; perianth regular. *Thymelaeaceae.*

Style terminal; ovary 2-celled; perianth irregular. *Polygaleae.*

Cells of the ovary more than 1-ovuled.

Leaves palmately compound (except in Oxalis monophylla); petals twisted in the bud; bulbous. *Geraniaceae* (incl. Oxalideae).

Leaves simple; not bulbous.

Stamens tetradynamous; corolla cruciform. *Cruciferae.*

Stamens and corolla not as above.

Trees.

Flowers unisexual dioecious; leaves alternate. *Bixaceae.*

Flowers hermaphrodite; leaves opposite. *Lythrarieae.*

Herbs or shrubs.

Sepals 2.

Corolla irregular; leaves multipartite; often with tendrils. *Papaveraceae.*

Corolla regular; leaves entire; never bearing tendrils. *Portulaceae.*

Sepals or calyx segments more than 2.

Styles distinct to the base.

Ovary 4—5-celled; corolla yellow. *Lineae.*

Ovary 1-celled; corolla pink or white. *Caryophylleae.*

Styles more or less combined.

Ovary 1-celled.

Low prostrate herbs inhabiting sea-shore; corolla pink. *Frankeniaceae.*

Habit not as above; flowers cream in dense heads. *Bruniaceae.*
Ovary more than 1-celled.
Ovary lobed; style central arising from the base between the lobes; leaves gland-dotted and strongly scented. *Rutaceae.*
Ovary, style and leaves not as above.
Shrubs; inflorescence cymose, capitate or spicate.
Flowers with a prominent disc; leaves not heath-like. *Celastrineae.*
Flowers without a prominent disc; leaves heath-like. *Bruniaceae.*
Herb; flowers solitary in the axils of the upper leaves. *Lythrarieae.*

2. Petals more or less united.
Ovary superior.
Perianth regular (i.e. the members in each whorl similar in shape, size and texture).
Ovary 2—4-lobed, the lobes often completely separating the ovary into 2—4 parts; style central (except in *Heliotropium*). *Boragineae.*
Ovary not lobed; style terminal.
Ovary more than 1-celled.
Ovary 4—8-celled.
Anthers opening by pores. *Ericaceae.*
Anthers opening by slits.
Leaves compound. *Geraniaceae* (incl. Oxalideae).
Leaves simple.

Stamens equal in number to petals, and opposite to them.

Shrubs or trees; stamens not epipetalous; fruit a drupe. *Myrsineae.*

Herbs; stamens epipetalous; fruit a circumscissile capsule. *Primulaceae.*

Stamens if equal in number to petals not opposite to them.

Leaves fleshy; gynaeceum apocarpous. *Crassulaceae.*

Leaves not fleshy; gynaeceum syncarpous.

Corolla plicate in aestivation; procumbent or climbing herbs. *Convolvulaceae.*

Corolla imbricate in aestivation; trees or shrubs.

Stamens equal in number to petals. *Ilicineae.*

Stamens twice as many as petals.

Stamens all bearing anthers. *Ebenaceae.*

Stamens 10, outer whorl not bearing anthers. *Sapotaceae.*

Ovary 2-celled.

Stamens 2. *Oleaceae.*

Stamens 3 or more.

Corolla scarious; flowers small, conspicuously protogynous; capsule circumscissile. *Plantagineae.*

Corolla, flowers and capsule not as above.

Calyx in a broken whorl (i.e. some of the sepals appearing to be within the others). *Convolvulaceae.*

Calyx in a complete whorl.

Flowers gynandrous (i.e. stamens adherent to carpels). *Asclepiadaceae.*

        - Flowers not gynandrous.
          - Ovules numerous.
            - Leaves opposite; flowers yellow or pink. *Gentianaceae.*
            - Leaves alternate; flowers white or mauve. *Solanaceae.*
          - Ovules 1—4.
            - Anthers dehiscing by pores. *Ericaceae.*
            - Anthers dehiscing by slits. *Verbenaceae.*
      - Ovary 1-celled.
        - Anthers dehiscing by pores. *Ericaceae.*
        - Anthers dehiscing by slits.
          - Styles single; calyx herbaceous; leaves opposite or whorled. *Verbenaceae.*
          - Styles 5; calyx scarious; leaves alternate. *Plumbagineae.*
- Perianth irregular (i.e. the members of each whorl dissimilar in shape, size or texture).
  - Ovary 4-celled and 4-lobed; style central. *Labiatae.*
  - Ovary 1—2-celled; style terminal.
    - Fruit more or less drupaceous or nut-like, always indehiscent; leaves often heath-like.
      - Anthers 2-celled.
        - Perianth of 3 members; stamens 7. *Polygaleae.*
        - Perianth of 4—5 members; stamens 4.
          - Flowers capitate; cells of ovary 1—2-ovuled; leaves usually opposite or whorled. *Verbenaceae.*
          - Flowers solitary; cells of the ovary 4—6-ovuled; leaves alternate. *Myoporineae.*
      - Anthers 1-celled. *Selagineae.*
    - Fruit capsular or succulent; leaves usually not heath-like.
      - Ovary 1-celled.
        - A root parasite; flowers mauve and yellow; stamens 4. *Orobanchaceae.*

              - Plants growing in wet mossy places, provided with bladder-like organs below the leaves; scape very slender; stamens 2. *Lentibularieae.*
            - Ovary 2-celled.
              - Perianth of 3 members; stamens 7—8. *Polygaleae.*
              - Perianth of 4—5 members; stamens 2—4. *Scrophulariaceae.*
    - Ovary inferior.
      - Ovary 1-celled; cell 1-ovuled.
        - Anthers syngenesious. *Compositae.*
        - Anthers free. *Dipsaceae.*
      - Ovary more than 1-celled.
        - Anthers syngenesious. *Campanulaceae.*
        - Anthers free.
          - Leaves exstipulate. *Campanulaceae.*
          - Leaves stipulate. *Rubiaceae.*

- b. Incompletae (one or both whorls of the perianth absent).
  - 1. Only one whorl of the perianth present.
    - Perianth woody; root parasite with no leaves. *Cytinaceae.*
    - Perianth not woody; foliage or scale leaves present.
      - Ovary inferior.
        - Flowers unisexual.
          - Parasites.
            - Twining. *Laurineae.*
            - Not twining.
              - Root parasites; dioecious. *Cytinaceae.*
              - Branch parasites; monoecious. *Loranthaceae.*
          - Not parasites.
            - Anthers opening by valves; tree. *Laurineae.*
            - Anthers opening by slits; not trees.
              - Leaves radical; without tendrils. *Halorageae.*
              - Leaves cauline; with tendrils. *Cucurbitaceae.*
        - Flowers hermaphrodite.
          - All leaves radical. *Halorageae.*
          - Cauline leaves present.
            - Ovary 1-celled.

            - Anthers opening by valves. *Laurineae.*
            - Anthers opening by slits.
                - Perianth imbricate in aestivation; styles 2—4; ovules solitary, basal. *Chenopodiaceae.*
                - Perianth valvate in aestivation; style solitary; ovules 2—4, pendulous. *Santalaceae.*
        - Ovary with more cells than 1. *Ficoideae.*
- Ovary superior.
    - Leaves stipulate (except in Scleranthus, Illecebraceae).
        - Flowers hermaphrodite.
            - Ovary 1-celled; cells 1-ovuled.
                - Leaf petiole dilated at base into a membranous sheath (ochreate stipule). *Polygonaceae.*
                - Leaf petiole not dilated at base; stipules scarious. *Illecebraceae.*
            - Ovary more than 1-celled.
                - Inflorescence racemose; fruit fleshy or juicy; leaves up to 1¾ in. broad. *Phytolacceae.*
                - Inflorescence not so; fruit dry; leaves rarely up to ½ in. broad. *Ficoideae.*
        - Flowers unisexual or polygamous.
            - Ovary more than 1-celled. *Euphorbiaceae.*
            - Ovary 1-celled. *Urticaceae.*
                - Stipules sheathing at base (ochreate). *Polygonaceae.*
                - Stipules not sheathing at base.
                    - Stipules scarious. *Illecebraceae.*
                    - Stipules not scarious. *Urticaceae.*
    - Leaves exstipulate.
        - Gynaeceum apocarpous.
            - Flowers racemose; carpels about 10. *Phytolacceae.*
            - Flowers not racemose; carpels more than 10. *Ranunculaceae.*
        - Gynaeceum syncarpous.
            - Ovary more than 1-celled.

Erect shrubs; leaves coriaceous, opposite; flowers tetramerous. *Penaeaceae.*

Decumbent herbs; leaves not coriaceous; flowers pentamerous (except sometimes tetramerous in Galenia and Polpoda). *Ficoideae.*

Ovary 1-celled.

Leaves whorled. *Ficoideae.*

Leaves not whorled.

Cells more than 1-ovuled; stamens very numerous. *Bixaceae.*

Cells 1-ovuled; fertile stamens not exceeding 12.

Anthers opening by valves. *Laurineae.*

Anthers opening by slits.

Calyx long or tubular.

Stamens in the points of the sepals; style terminal. *Proteaceae.*

Stamens not in the points of the sepals; style lateral. *Thymelaeaceae.*

Calyx short not tubular.

Calyx dry and coloured. *Amarantaceae.*

Calyx herbaceous and succulent. *Chenopodiaceae.*

2. Both whorls of the perianth absent.

Leaves stipulate.

Flowers amentaceous; tree; ovary 1-celled. *Salicaceae.*

Flowers not amentaceous; 1 ♀ and several ♂ enclosed in a cup; herbs with milky juice; ovary 3-celled. *Euphorbiaceae.*

Leaves exstipulate.

Flowers hermaphrodite; not amentaceous. *Piperaceae.*

Flowers unisexual; amentaceous. *Myricaceae.*

B. Monocotyledones (leaves parallel-veined; whorls of the perianth composed of 3 members).

Perianth present.

Both whorls of perianth present.

Both whorls of perianth petaloid.

Ovary inferior.
Flowers gynandrous. *Orchideae.*
Flowers not gynandrous.
Stamens 3.
Stamens opposite outer perianth-segments. *Irideae.*
Stamens opposite inner perianth-segments.
Flowers panicled. *Haemodoraceae.*
Flowers solitary. *Amaryllideae.*
Stamens more than 3.
Anthers dehiscing by pores. *Haemodoraceae.*
Anthers dehiscing by slits. *Amaryllideae.*
Ovary superior.
Stamens 3. *Haemodoraceae.*
Stamens 6.
Anthers dehiscing by pores *Haemodoraceae.*
Anthers dehiscing by slits *Liliaceae.*
One whorl of perianth or both calycine.
Flowers dioecious. *Restiaceae.*
Flowers hermaphrodite.
Inner whorl of perianth petaloid or sepaloid.
Leaves radical.
Inner perianth-segments yellow, petaloid. *Xyrideae.*
Inner perianth-segments greenish, sepaloid. *Naiadaceae.*
Leaves cauline. *Commelinaceae.*
Inner whorl of perianth glumaceous. *Juncaceae.*
One whorl of the perianth absent. *Naiadaceae.*
Perianth not present or consisting of more or less insignificant scales or bristles.
Flowers glumaceous.
Stems hollow; anthers versatile. *Gramineae.*
Stems solid; anthers basifixed. *Cyperaceae.*
Flowers not glumaceous (naked).
Flowers on a spadix.
Fruit a berry; spathe present. *Aroideae.*
Fruit dry; spathe not present. *Typhaceae.*
Flowers not on a spadix. *Naiadaceae.*
II. Gymnosperms (ovules not enclosed in an ovary). *Coniferae.*

(*To be continued*)

# NATIONAL BOTANIC GARDENS

The establishment of the National Botanic Gardens at Kirstenbosch, a part of the Groote Schur Estates, was sanctioned by the Government and approved by Parliament during the session of 1913.

The Government grant is administered by the Department of the Interior. The Gardens are directly controlled by a Board of five trustees to which there have been nominated:

A. By the Government:

Lord de Villiers.

Sir David de V. Graaff, Bart., M.L.A.

Sir Lionel Phillips, Bart., M.L.A.

B. By the Capetown municipality:

The Mayor of Capetown.

C. By the Botanical Society of South Africa:

W. Duncan Baxter, M.L.A.

The Trustees have made the following appointments:

Hon. Director: H. H. W. Pearson, Sc.D., F.L.S.

Secretary: Miss H. J. Davison, B.A.

Curator: J. W. Mathews, F.R.H.S.

Ranger: J. Rohland.

The Kirstenbosch Estate passed under the control of the Trustees on July 1. Surveys of the estate and of the rich native flora still remaining there are in progress. A nursery ground is enclosed and is rapidly being filled by gifts from all parts of South Africa. More than 1000 species were received before the end of November. Contributions of plants, bulbs, seeds, etc., may be sent free by post or rail if addressed

O. H. M. S.
The Director,
National Botanic Gardens,
Kirstenbosch,
Newlands, Cape.

The establishment of a large and representative collection of South African plants is not an end in itself. It is but a necessary preliminary to scientific and economic investigations, the need for which has been widely felt during recent years. To use to advantage the resources now available at Kirstenbosch demands a staff and an equipment which must be supplied in the near future. In the meantime it is proposed to commence at once a study of certain well-known or reputed drug- and perfume-yielding plants. Prominent among these will be the Buchu.

Everyone who has given attention to the Buchu industry is aware that it is capable of considerable development and that the key to its improvement lies in the study of the species from which it is derived—particularly of their behaviour under cultivation. The following is an extract from a letter (dated May 22, 1913) received from a Canadian medical practitioner:

"I am interested in Buchu leaves....It is very difficult for us to obtain sufficient and good supplies. I was wondering if our climate is enough like yours to permit their successful growth in this country."

If prompt measures are not taken to get the Buchus into cultivation in this country and to improve the supply of the drug, there is every possibility that the wild plants which yield it will be gradually exterminated by the present methods of collection, assisted by fire, and that the Buchu industry will be transferred to other countries where the Barosmas have been brought into cultivation.

The cooperation of those who may be in a position to supply seeds or plants of species popularly used for purposes of medicine or perfumery is invited.

# REVIEW

VEGETATION OF THE PEAK DISTRICT. By C. E. Moss. *Cambridge University Press*, 1913. 8vo. pp. x, 235; figs. 33; maps 5. Price 12*s.* net.

It is a far cry from South Africa to the Pennines. Nevertheless, this study of the vegetation of the Peak District contains much that should be of interest to students of the vegetation of South Africa. In South Africa we are still engaged in discovering new species and in learning the elements of the distribution of those which are not new. This is the spade work which, in general, must precede a more intensive study of the vegetation as a whole or of the species which compose it. A few studies of an ecological character have been undertaken in South Africa[1] and there is an enormous scope for their extension.

The work before us gives the results of a comprehensive and detailed survey of the plant-communities of the Peak District and of the conditions which control their origin, their existence and their disappearance. This branch of botanical enquiry is yet in its infancy and, in the words of one of its pioneers, "what we do not know seems infinite." The author of this work is taking a prominent part in the organization and execution of ecological research in England; his methods and conclusions are worthy of the close attention of any who propose to advance the study of South African Botany by pursuing similar investigations here. The Peak District affords several striking examples of plant-communities comparable in many respects with some which are characteristic of certain parts of South Africa; therefore, even the detailed account of its associations is not without its interest to those whose sphere of work is in this country. But of stronger appeal probably will be the valuable discussion and application of general principles contained in the Introduction (pp. 1—37).

It frequently occurs in the early stages of the development of a branch of science that there is difficulty in arriving at a consensus of opinion as to the precise meaning of even the fundamental conceptions upon which its deductions are founded. This is conspicuously the case in ecology in which, among the many points regarding which the workers are at variance is the limit to be assigned to the principal unit of classification, the "formation." Dr Moss, voicing the views of the English school, defines a formation as "the whole of the vegetation which occurs on a definite and essentially uniform habitat" (p. 19). This implies of course that (1) the same formation cannot exist in two distinct geographical areas, and (2) while the species and even perhaps the growth-forms in a given locality may disappear and give place to new ones, yet the formation remains the same. On the continent there is rather a tendency to take another view of the connotation of the term "formation." In the opinion of E. Warming, for example, "a formation appears with a certain determined uniformity and physiognomy, even in different parts of the world and even when the constituent species are very different and possibly belong to different genera and families." Warming, in agreement with a body of continental ecologists, does not include the succession of evolutionary stages in the idea of "formation"—i.e. the same definite and essentially uniform habitat may support a succession of different formations at successive periods. This divergence of opinion is considerable and there is much to be said in favour of either view. In the interests of ecology a general agreement on so fundamental a question is much to be desired. The greater the interest taken in the subject and the more widespread its study in the field, the sooner will this goal be reached.

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[1] E.g. Bews, J. W., "The Vegetation of Natal," *Annals of the Natal Museum*, II. 3, 1912.

As the author points out, the Peak District possesses no definite geographical boundaries. For the purposes of this book the area considered measures approximately 400 square miles. In it there are recognised five of the fourteen British plant-formations, viz. those of (1) Calcareous soils, (2) Siliceous soils, (3) Acidic Peaty soils (Moor Formation), (4) Fresh waters, (5) Cultivated land. In the northern half of the area (i.e. the plateau known as the Peak), No. 3 is by far the most extensive; in the southern section, cultivated land predominates. The associations marked by the presence of Heaths and Vaccinium are of course characteristic of the moors (No. 3).

To South African readers the remarks upon various retrogressive associations will be of particular interest (see pp. 20, 21, 97, 98, 188). South Africa should be a fruitful field for the study of the deterioration and disappearance of stable communities from large areas over which their predominence was once unchallenged—a study of no little economic importance.

The book is written in an interesting manner and is free from that embarrassing richness of formidable technical terms which has characterised many ecological treatises. The majority of the photographs used for illustration are excellent and well reproduced. The work may be confidently recommended to any intending to follow this fascinating branch of botanical study.

# EXPLANATION OF PLATES

## PLATE I

### ZYGOPHYLLUM TENUE, Glover.

1, two leaves and flower × 4; 2, sepal × 6; 3, petal × 6; 4, stamen, front view; 5, stamen, back view × 6; 6, gynaeceum × 10; 7, capsule × 5.

## PLATE II

### HERMANNIA GARIEPINA, E. & Z.

1, sketch of a branch, nat. size; 2, flower, side view; 3, one of the petals, front view; 4, one of the stamens, back view; 5, ditto, front view—all × 2; 6, gynaeceum × 3; 7, fruit × 4.

## PLATE III

### HERMANNIA HELIANTHEMUM, K. Schum.

1, sketch of a branch, nat. size; 2, one of the petals; 3, one of the stamens, front view; 4, ditto, back view; 5, andraeceum; 6, gynaeceum—all × 2; 6, gynaeceum × 3; 7, fruit × 2; 8, flower, side view × 2.

## PLATE IV

### LEBECKIA OBOVATA, SCHINZ.

1, sketch of a branch; 2, flower, front view, nat. size; 3, longitudinal section of flower, × 2; 4, flower, side view, nat. size; 5, calyx, laid open; 6, vexillum; 7, one of the alae; 8, carina; 9, andraeceum, flattened; 10, gynaeceum—all × 2.

## PLATE V

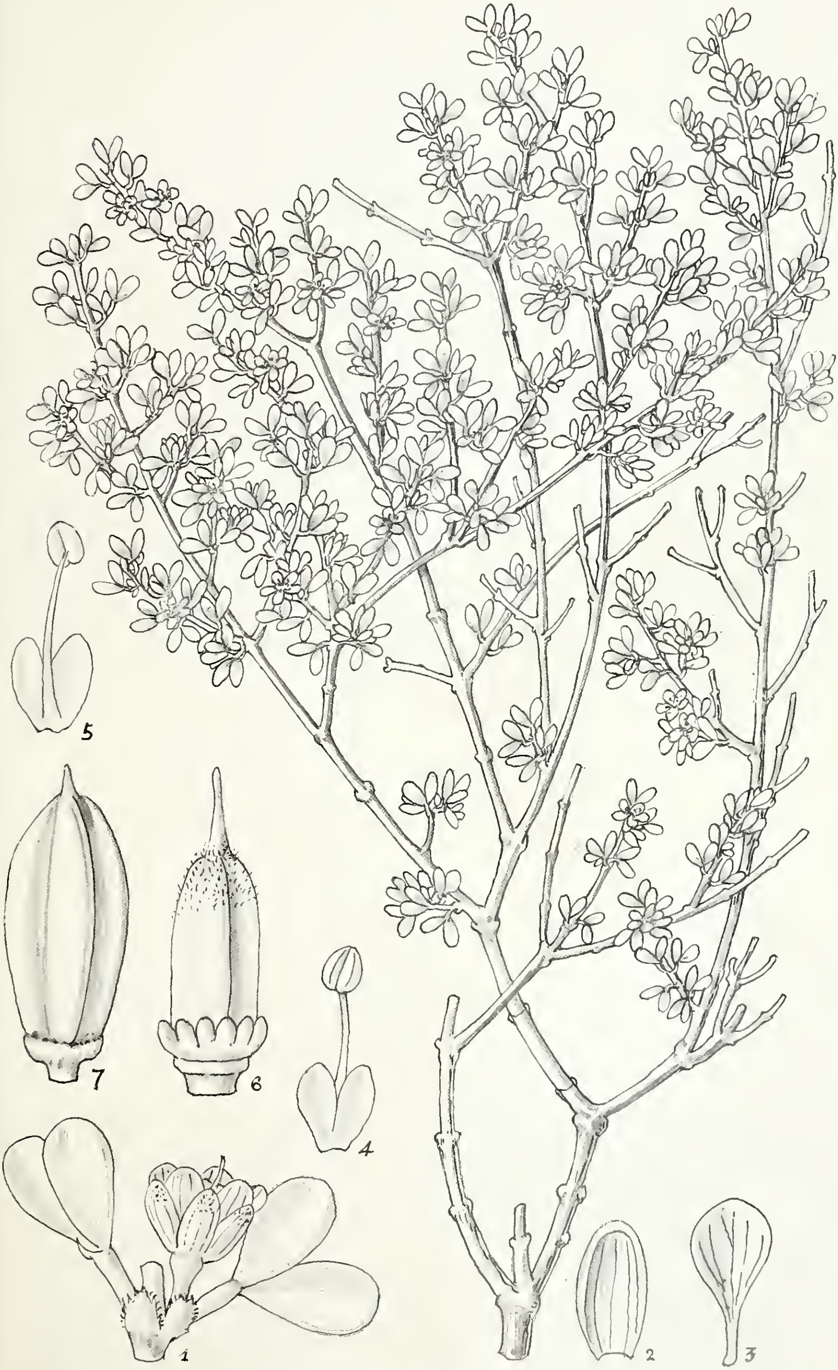
### MELOLOBIUM KARASBERGENSE, L. Bolus.

1, sketch of a branch, nat. size; 2, flower, side view; 3, bract; 4, calyx, laid open; 5, vexillum; 6, one of the alae; 7, carina—all × 3; 8, andraeceum, flattened × 6; 9, gynaeceum; 10, longitudinal section of ditto × 2; 11, legume; 12, leaf with stipules × 2; 13, 14, stipules from the same branch × 3.

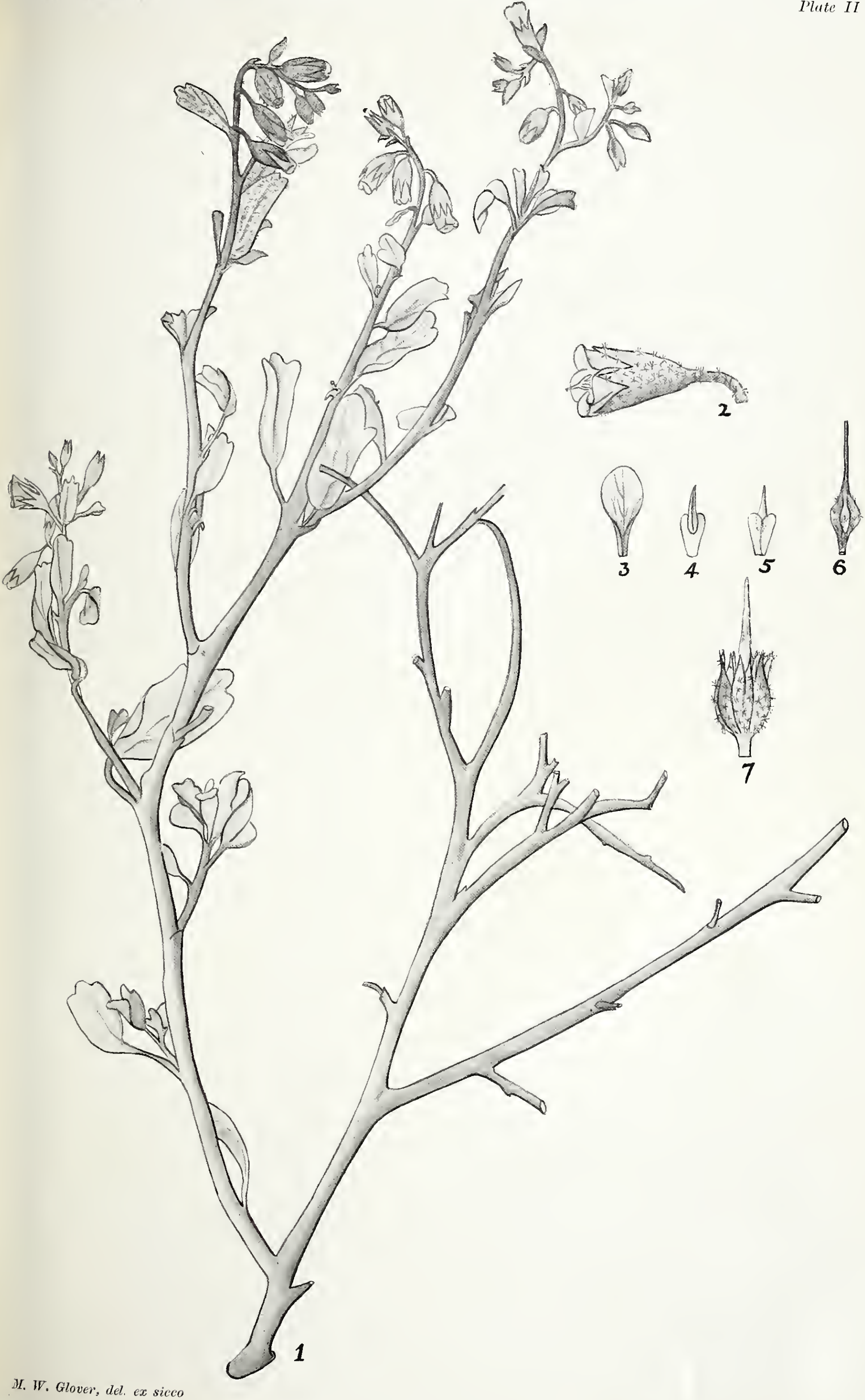
## PLATE VI

### HOFFMANSEGGIA PEARSONII, Phillips.

1, sketch of a branch, nat. size; 2, flower, side view; 3, ditto, front view; 4, calyx, laid open, back view; 5, ditto, front view; 6, petals; 7, stamens; 8, gynaeceum; 9, ditto, longitudinal section; 10, one of the pinnae; 11, young stipule—all × 2.

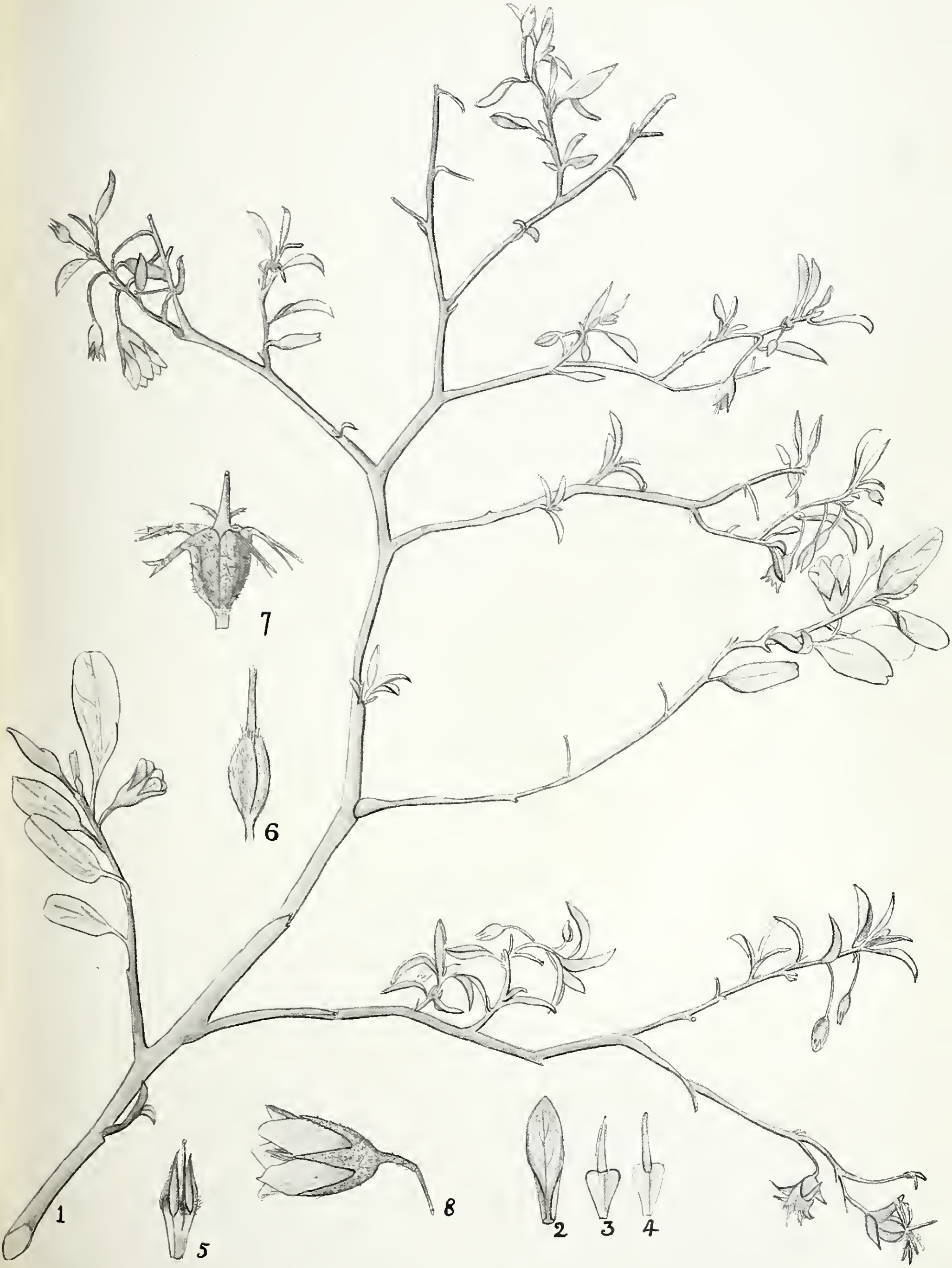


Zygophyllum tenue, Glover



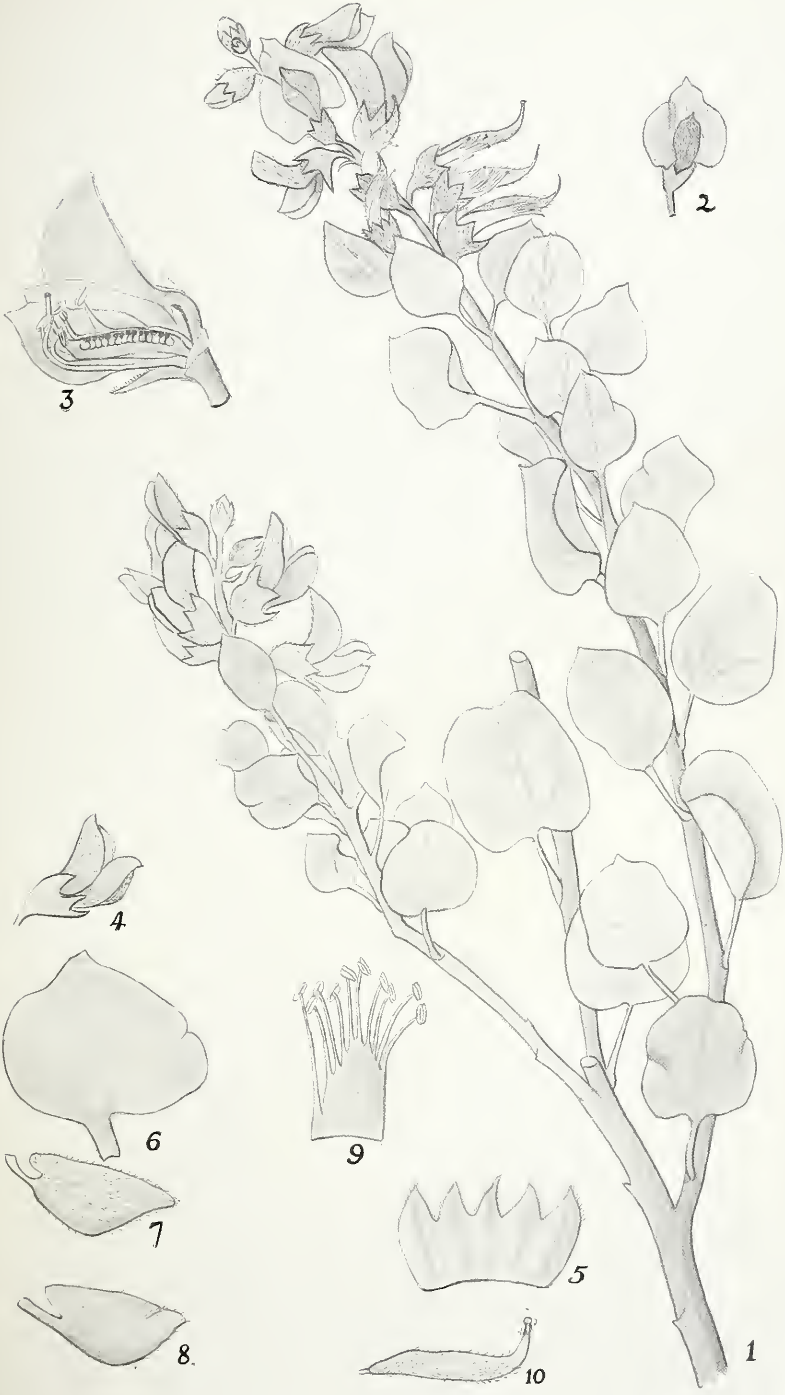
M. W. Glover, del. ex sicco

Hermannia gariepina, E. & Z.



*M. W. Glover, del. ex sicco*

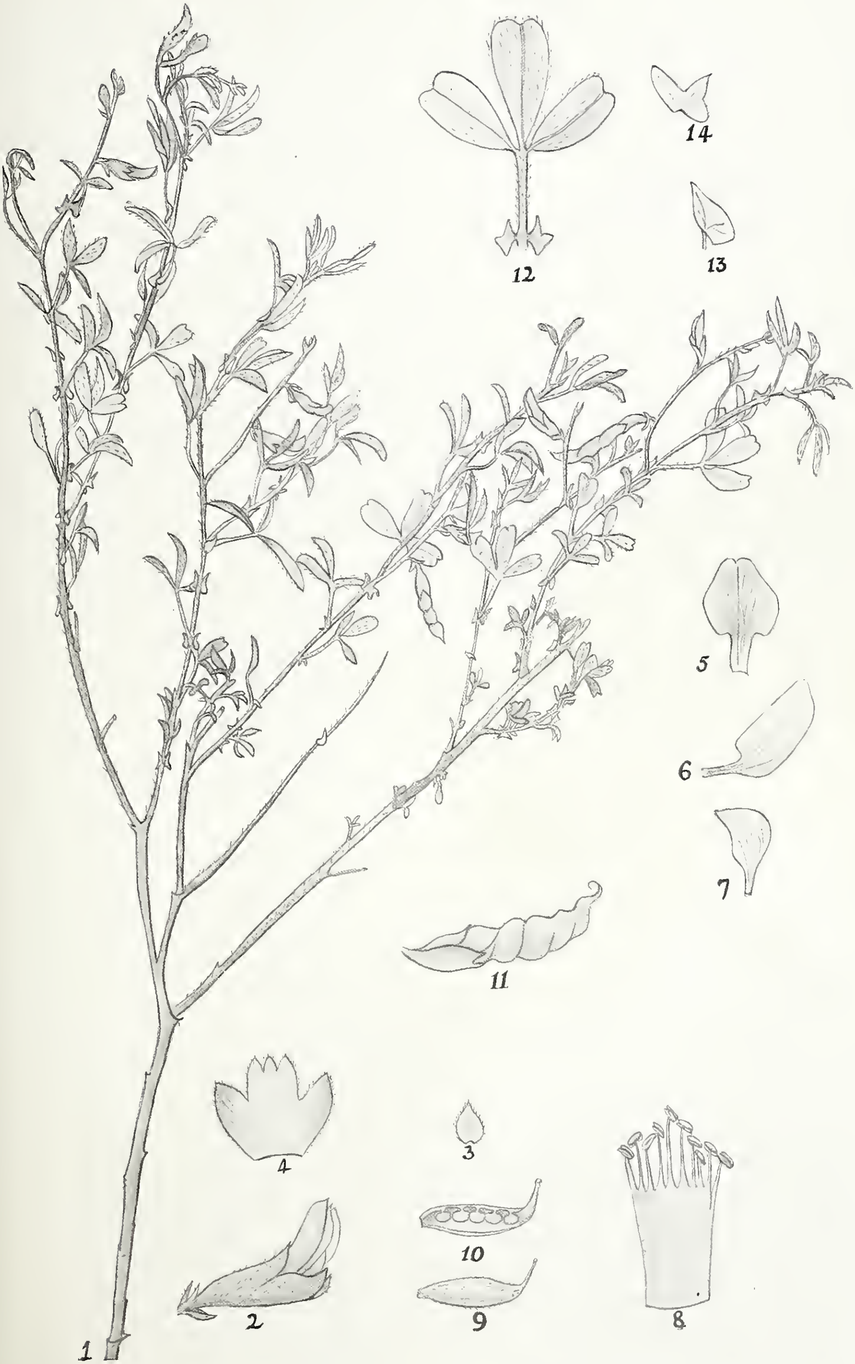
Hermannia Helianthemum, K. Schum.



*M. W. Glover, del. ex sicco*

Lebeckia obovata, Schinz.

*Plate V*



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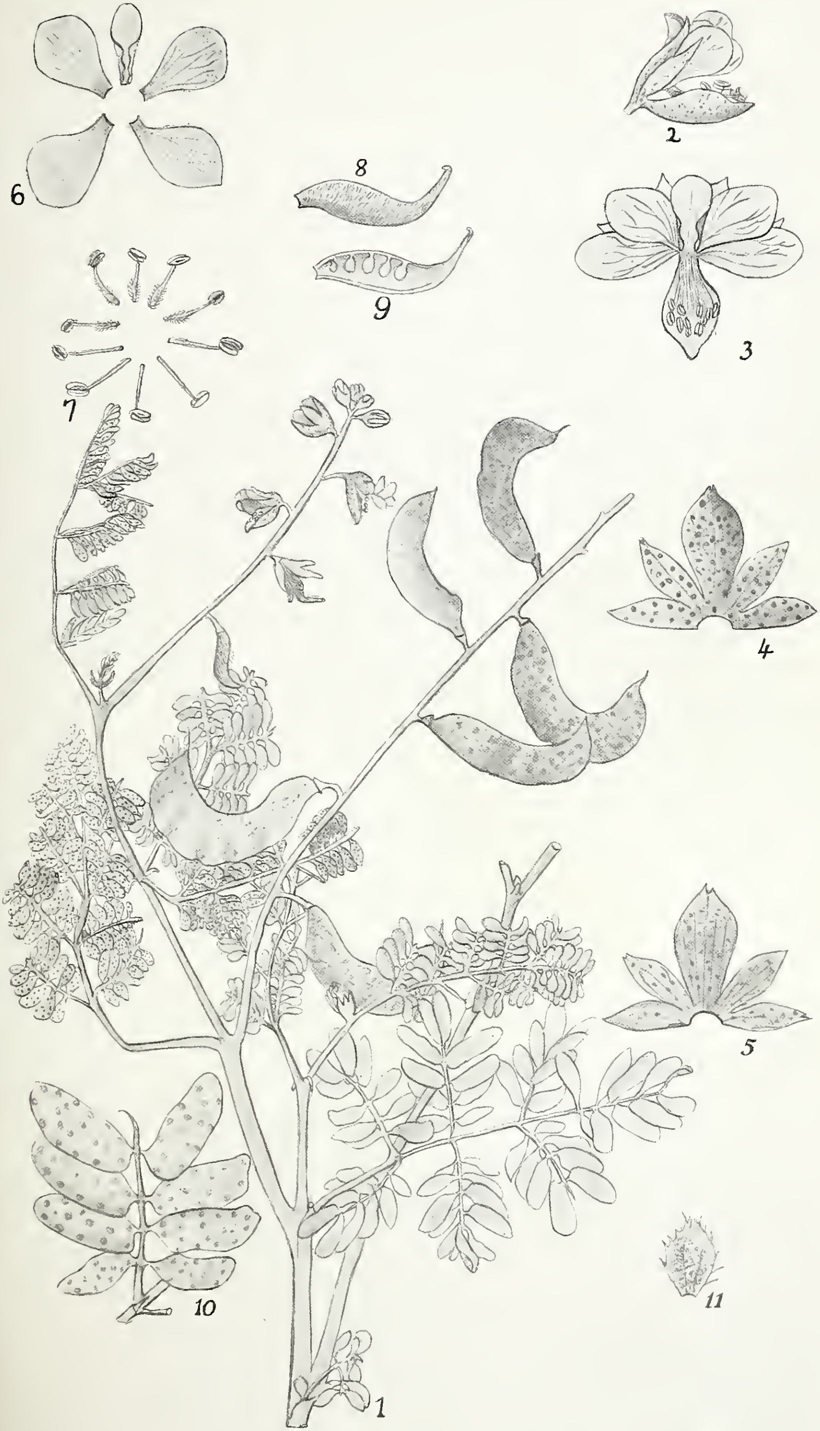
Melolobium karasbergense, L. Bolus



*M. W. Glover, del. ex sicco*

Hoffmanseggia Pearsonii, Phillips

VOLUME I NOVEMBER, 1914 No. 2

# OBSERVATIONS ON THE INTERNAL TEMPERATURES OF *EUPHORBIA VIROSA* AND *ALOE DICHOTOMA*[1]

BY H. H. W. PEARSON

## 1. INTRODUCTION.

THE observations recorded below were made in the course of the Percy Sladen Memorial Expedition to the Great Karasberg in Great Namaqualand, in the summer of 1912–13. The plants chosen for the purpose were growing on the lower western slopes of the Great Karasberg, near the military station Wasserfall Alt, at an elevation of 4200 ft. These slopes receive little rain; their perennial vegetation consists mainly of *Euphorbia virosa* and another species of similar habit, *Aloe dichotoma* and the Capparidaceous tree, *Maerua arenicola*. At the time of our visit very little rain had yet fallen and, except in the sandy river beds, there were no annuals. The locality is one in which the summer temperatures are high. Strong winds are frequent—at times of daily occurrence; they come, however, from the hot desert plains below or from the Kalahari; in either case their direct cooling effect is small. The situation is open to the west and north-west, but to the east is closed by mountains which rise to more than 6000 ft. But, although it is in ordinary language a "hot" place, it is undoubtedly cooler than many localities in the desert, 3000 ft. lower down. If any of the desert plants possess a structure so favourable to the development of a high temperature as that found in *Euphorbia virosa*, they probably attain higher maxima than those recorded here. And further, although the habit and structure of this plant are such as apparently to necessitate an exceedingly low rate of transpiration, nevertheless its massive stems are freely exposed to the air. Other things being equal, one would expect a dwarf succulent wedged in a rock-crevice, or between stones, to be liable to attain a higher internal temperature. And finally, the following observations were made in December, that is, in early summer. The mean temperatures in February and March are higher than in December.

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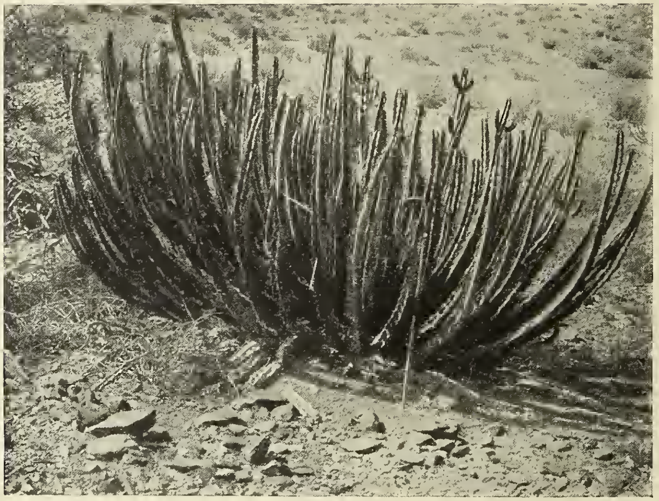
[1] *Percy Sladen Memorial Expeditions in South-West Africa* (assisted by grants from the Royal Society and the South African Government), *Report No.* 21.

Therefore the maxima of internal temperature may be higher later in the summer than during December. On the other hand, the few very small leaves of *Euphorbia virosa* appear in January, and the soil is normally moister at the end than at the beginning of the summer. Conditions are therefore most favourable for transpiration and surface-evaporation during the hottest months. In view of what has now been stated, it will be seen that the results here recorded are not to be regarded as extreme. It is probable that the great bulk of the vegetation of Great Namaqualand and of some parts of Little Namaqualand must protect itself against higher air-temperatures and more powerful solar radiation than obtain here, or must endure higher internal temperatures than those now recorded. And, indeed, higher internal temperatures than those obtained in these experiments have been recorded by other observers[1], even in plants growing normally in a cooler climate.



Photograph 1. *Euphorbia virosa* (Euphorbia *A*), Wasserfall, Great Karasberg, 4200 ft. December, 1912.

*Euphorbia virosa* (Photograph 1) is a comparatively shallow rooted plant with numerous 5–7 angled suberect or ascending branches arising from a short main stem to a height of 5–8 feet. The first aerial shoot of the seedling, which in due course becomes the main stem, has all the external characters of the later-formed primary branches. Secondary branches in this locality are rare; if present they are seldom more than a few inches in length. The projecting angles of the branch are beset by short curved thorns; they run longitudinally, rarely spirally, from base to apex; they are separated by broad shallow grooves in which the assimilating tissue is concentrated and protected by an epidermis with a smooth thick cuticle. Of the three plants used in the experiments, *A* and *C* were in fruit; *B* was a young plant about 1½ feet high, which apparently had not yet flowered; all were leafless.

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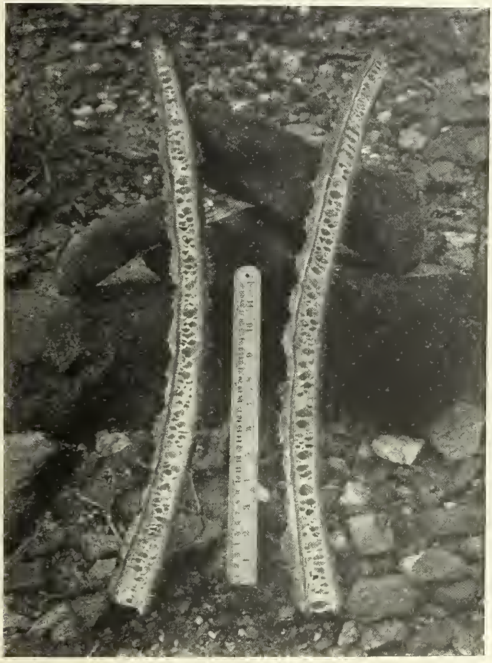
[1] Jost, L., '07, p. 44.

The diameter of a normal branch is from 1½–2 inches, of which considerably more than half is occupied by the pith; this tissue is broken up by a series of large air-cavities separated from one another by diaphragms of parenchymatous tissue containing ramifications of the latex-system[1] (Photograph 2). So great a development of air-spaces in a succulent plant is very remarkable and appears at the moment to be unique.



Photograph 2. Stem of *Euphorbia virosa*, in longitudinal section. (Photograph of freshly-sectioned living stem.)

The general form of *Aloe dichotoma* is sufficiently well known (Photograph 3). The smooth, shining, greyish-yellow bark of the trunk must have an effect in maintaining a low rate of absorption of heat-rays as well as in preventing evaporation. The wood of a thick trunk is mostly of secondary origin. It contains a large percentage of water and comparatively small intercellular air-spaces[1].

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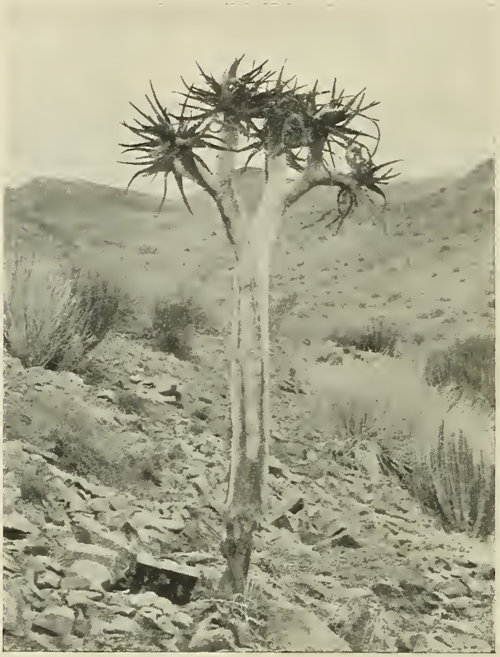
[1] See Worsdell, '14.



Photograph 3. *Aloe dichotoma* (Aloe *B*), Wasserfall, Great Karasberg. December, 1912.

## 2. METHODS.

The work was done during the course of an expedition undertaken for other purposes. Only ten days (Dec. 12–21, 1912) could be devoted to it, and this only because the principal work of the expedition was, for the time being, hindered by lack of rain. The methods employed were necessarily rough. With more suitable instruments and more time to devote to this purpose, the observations now recorded could be usefully carried further in more than one direction.

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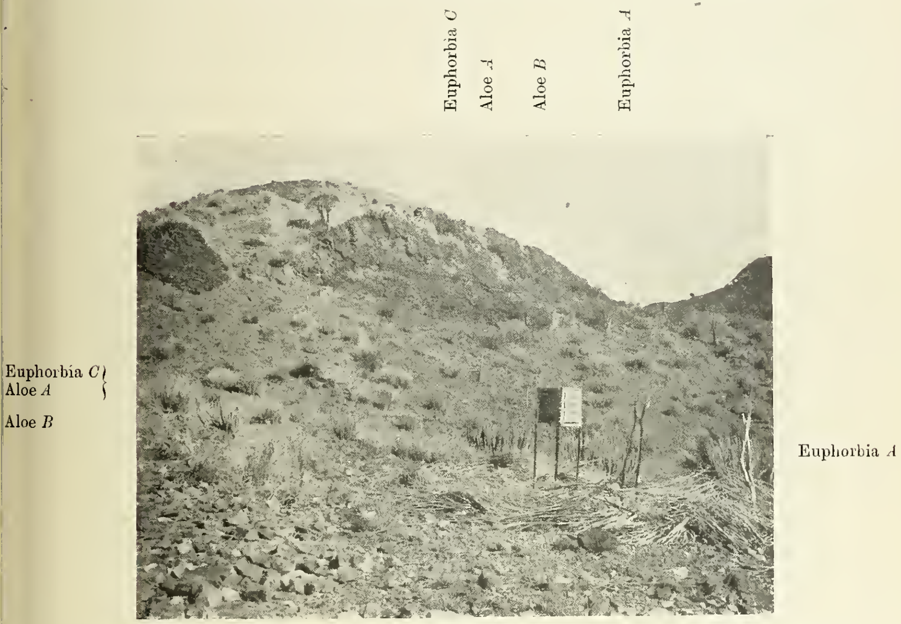
[1] Worsdell, *l.c.*

In the wounding experiments the observations were made at intervals of 2 minutes; in other cases, of 30 minutes. The thermometers were read to 0°·25 C.

The direct heating effect of the sun's rays was measured by a Negretti and Zambra's Black-Bulb-in-vacuo thermometer, kindly lent for the purpose by Mr S. S. Hough, F.R.S. This thermometer was supported on two poles, 4 feet from the ground, a few feet from the screen. A Stephenson's screen of the regulation pattern and size was specially made, with the parts detachable for easy transport (Photograph 4). This was erected in such a manner that the centre of the box was four feet from the ground. The shade temperatures used in the following tables and curves were obtained from a thermometer hung in this screen; its readings were checked by comparison with those of standardised maximum and minimum thermometers, for the loan of which I am indebted to the Director of the Union Department of Irrigation and Meteorology. These thermometers were erected about 15 feet from two of the Euphorbia bushes (*A* and *B*), whose internal temperatures were to be observed.



Photograph 4. Stephenson's screen, Radiation thermometers and Plants used in Experiments. (The plant Euphorbia *B* is out of sight, behind the screen a little to the left of Euphorbia *A*.)

The results of the first few days' observations made it desirable to perform similar experiments with other succulents. The only suitable plants in the neighbourhood were two trees of *Aloe dichotoma* (*A* and *B*), growing at a slightly higher elevation some 300 yards to the east of the screen, on the steep slope of a hill facing north-west. The direct investigation of the relations between the shade temperature and the internal temperatures of these plants would have necessitated the erection of a second screen in their immediate vicinity. This, however, was impossible. The omission was as far as possible made good by concurrent readings of the internal temperatures of a Euphorbia (Euphorbia *C*) growing about 6 yards from one of the aloes and 10 yards from the other. The temperatures of this Euphorbia when compared with those obtained from plants close to the screen (Euphorbia *A* and *B*) give some idea of the extent to which the local conditions affecting the aloes differed from those prevailing near the screen.

The thermometers used for the readings of internal temperature were pushed into the stem far enough to place the bulbs approximately in the centre. The internal temperature actually measured in the Euphorbia is therefore that of the gas contained in the pith cavities. In the case of the Euphorbia, a small hole was first made with an awl. A flow of latex followed, and, as it congealed, it securely sealed the thermometer in place. In the Aloe a hole was easily made in the soft wood with a narrow scalpel. The stem of the thermometer was tightly plugged in position with cotton wool; care was taken not to place any cotton wool between the bulb and the internal tissues. In both cases the stem of the thermometer was inclined above the horizontal just sufficiently to ensure that when the mercury contracted the thread did not break.

The thermometers used are distinguished by the following symbols; in the charts, the curves of their readings are denoted by various types of lines as indicated below:

| Thermometer | Symbol | Line |
|---|---|---|
| Black-Bulb-in-vacuo . . | *BB* . . | – ·· – ·· – ·· – ·· – ·· – |
| Shade (in screen) . . . | *Sh* . . | ×××××××××××××× |
| Thermometers used for readings of internal temperature | *W* . . | - - - - - - - - - - - - - |
| | *T* . . | ........................ |
| | *P* . . | — — ———————— — |
| | *Iv* . . | –o–o–o–o–o–o– |

### 3. Observations on Normal Internal Temperatures.

The observations made on December 13 and 18 may be taken as typical of the rest in regard to the relation between the sun, shade, and internal temperatures.

December 13.

Chart I (11 A.M. to 5.30 P.M.).

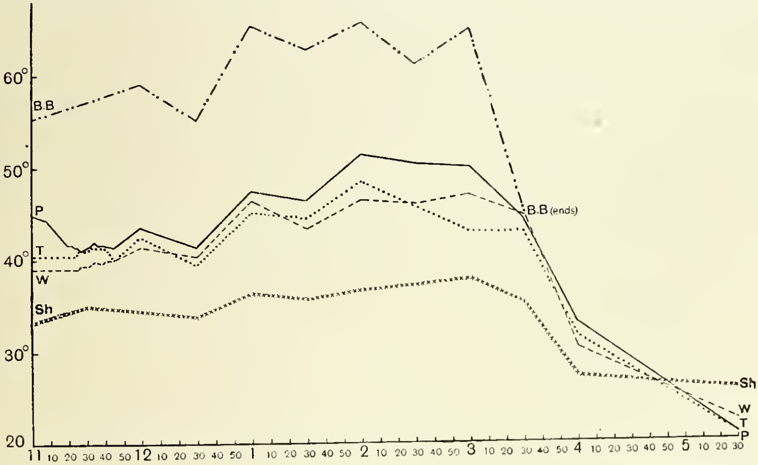
Euphorbia A. A large plant of *E. virosa* situated about 15 yards south of the screen (see Photograph 4). Three thermometers (viz. *W*, *T*, *P*) were inserted in three branches of this plant.

Readings were taken every 30 minutes from 5 A.M. to 5.30 P.M. The closer series from 9–10 and from 11–12 (Wounding Experiments 1 and 2 are described later).

At 5 A.M. the following were the temperatures observed:

*BB*, 23°·3; *Sh*, 24°·2; *T*, 23°·5; *P*, 24°·0; *W*, 24°·5 C.

CHART I. December 13. Euphorbia *A* (Thermometers *W*, *T*, *P*).

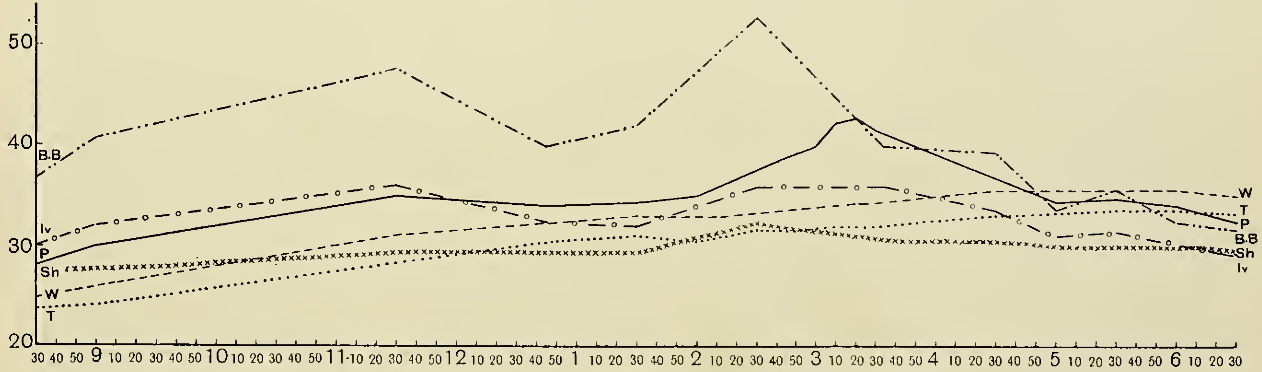


All except the shade temperature began to rise soon after 5.30. Between 5.30 and 6 the sun appeared from behind the hill and just touched the tops of the branches under observation at 6.30. From this moment they all rose more rapidly. *T*, being illuminated later than the other two, did not cross the slowly rising curve of the shade temperature until nearly 7 o'clock.

The Black-Bulb (*BB*) temperature reached its recorded maximum (65·8 C.) at 2 o'clock, at which time also *P* and *T* are at their highest points, viz. 51°·5 and 48°·5 C. respectively. *W* attains its maximum (47°) one hour later. The zigzag character of the *BB* curve, which is reflected in those of *Sh*, *P*, *W*, and *T*, is due to passing clouds. The sky was "overcast" between 1 and 1.30 and again between 2 and 2.30, and after 3 the sun was completely hidden. A thunderstorm accompanied by wind from the north-east commenced at 3.40.

CHART II. December 18.

Euphorbia *B* (Thermometer *Iv*).
" *C* ( " *P*).
Aloe *A* ( " *T*).
" *B* ( " *W*).



From this point the fall of all the internal temperature curves is very rapid. At 5.30 the temperature of *W* is 19° C. lower than it was at the same hour on the previous day. It is to be noted that at 5.30 *P* and *T* are as much as 4°·9 C. and *W* 3° C. below the shade temperature. These low records are no doubt due partly to the fact that the rain ceased soon after 4 o'clock, while the wind continued and raised the rate of evaporation from the surface. So great a fall below the shade temperature was not again observed; but the course of the curves through the night was not determined. There is, however, little doubt that the minimum internal temperature is usually attained within the hour which immediately precedes sunrise.

The marked feature of these records is the rapid response shewn by the internal temperatures of the Euphorbia to changes in the Black-Bulb and shade readings. The passing of a light cloud over the sun has an immediate influence upon the temperature of the air enclosed in the pith cavities and therefore upon that of the cells of the tissues surrounding them. The stem of the Aloe, which, compared with that of the Euphorbia, contains proportionately more water and less air, is, as one would expect, much less rapidly influenced by external temperature-changes. This is seen in the observations of December 18.

December 18.

Chart II (8.30 A.M. to 6.30 P.M.).

| | | | |
|---|---|---|---|
| Euphorbia | *B.* | Thermometer | *Iv.* |
| „ | *C.* | „ | *P.* |
| Aloe *A.* | | „ | *T.* |
| „ *B.* | | „ | *W.* |

This was an exceptionally cool day. Rain had fallen during the night. At 7 A.M. the sky was still clouded, but the clouds soon afterwards dispersed. By 11.30 clouds had again appeared, and it was raining at 12.45. The sun was not again unclouded until 2 o'clock. At 3.10 the sky again became overcast, and during the rest of the afternoon the sun made only occasional reappearances. At 6.38 the sun had set to all the plants under observation.

The curve *Iv* (Euphorbia *B*) shews a close agreement with the *BB* and shade curves until 6 P.M., when it falls below the shade temperature and presumably remains below it until sunrise on the following morning.

From 7 until 11.30 A.M. the *P* curve (Euphorbia *C*) follows *Iv* fairly closely, remaining consistently below it. Towards midday it crosses it and for the rest of the day is far less dependent than is *Iv* upon the oscillations of *BB*. This is no doubt sufficiently explained by its situation on a steep hillside facing west. The external conditions affecting *P* are those which influence *T* (Aloe *A*) and *W* (Aloe *B*). These two curves are almost parallel after 7.30 A.M. They rise and fall more slowly than *P*; they attain much lower maxima and these much later in the day; they are much less affected by sudden and brief changes in external conditions.

### 4. Wounding Experiments.

The experiments now to be described were carried out with a view to determining the effects of surface wounding upon the internal temperatures of the Euphorbia and the Aloe. In the Percy Sladen Memorial Expedition to the Orange River in 1910–11, it was found that such an effect is produced in the stem of *Euphorbia Dregeana*. It was, however, impossible at that time to continue the observations long enough to establish the results. As *E. Dregeana* was not met with in the Karasberg, the experiments were repeated on *E. virosa*. In this species the effects are far more marked than in *E. Dregeana*, in consequence no doubt of the remarkable development of air-spaces in the pith.

No. 1. December 13.

Chart III.

Plant. Euphorbia *A*.
Thermometers. *W, T, P* in three separate branches.

At 9.10 a.m. the superficial tissues were scraped off about 1 square inch on the leeward side of the stem in the furrow opposite to that in which the thermometer *W* was inserted; the wounded area was so placed that its centre was as nearly as possible opposite to the bulb of the thermometer. Within 2 minutes the temperature fell 0°·75 C.; it continued to fall for the succeeding 5 minutes; after remaining stationary for 3 minutes it then fell slightly, the total fall being 1°·5 C.[1] After a further 3 minutes' rest, at 9.25, it began to rise again, more slowly than it fell, to the normal.

With regard to this record it may be noted that the temperature ceases to fall as the exuded latex forms a pellicle on the surface. It may therefore be concluded that the fall of internal temperature is at least in part the direct effect of the evaporation of the fluids of the latex at the surface. But it cannot be wholly due to this cause for it is inconceivable that the effects of this evaporation could be felt in the pith across the intervening tissues of the epidermis, cortex, vascular cylinder and outer pith practically instantaneously; nor is it to be explained by conduction through the glass of the thermometer since none of the evaporating latex is in contact with it. There is therefore another cause for the observed lowering of the internal temperature and one which acts more quickly than surface-evaporation. It is suggested that this cause is the expansion of the imprisoned gases of the pith consequent upon the exudation of latex. A confirmation of this hypothesis is found in the fact that the internal temperature of an unwounded branch of the same plant almost invariably falls or ceases to rise in apparent sympathy with the fall in the neighbourhood of the wound.

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[1] See Table I.

This was observed in the experiment under notice in the unwounded branches carrying the thermometers *T* and *P*. Thermometer *P* shews a distinct fall and recovery and *T* remains stationary; the periods of these effects correspond very closely with that of the fall and recovery at the wound. And further, the fall in *P* and the retardation of the rise in *T* both commence 5 minutes after the observed beginning of the fall in *W*. These effects cannot possibly be connected with surface-evaporation at *W*. If they have a purely physical explanation the most natural would seem to be the expansion of the pith gases. This expansion would be practically instantaneous at the wound. It would, however, be delayed in the more distant parts of the plant owing to the more tardy withdrawal of latex and probably also to the resistance of the cellular diaphragms which cut up the pith into cavities. These conclusions are confirmed by other experiments.

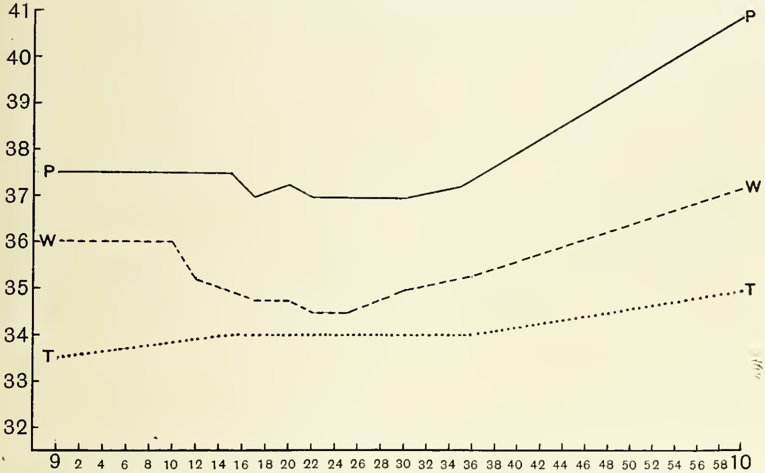


CHART III. December 13.
Euphorbia *A* (Thermometers *W*, *T*, *P*).

No. 2. December 13.

Chart I.

Plant. Euphorbia *A*.

Thermometers. *W*, *T*, *P* inserted as in No. 1.

The wound inflicted on the branch *W* at 9.10 was on the leeward side. At 11.5 the stem *P* was wounded in the same manner but in the windward side. If the fall in temperature in the wounded stem is in part due to evaporation, the fall should be more rapid in this than in the former case. The area wounded was as nearly as possible the same.

Between 11 and 11.5 (i.e. before the wounding) *P* fell 0°·25 C. for unexplained reasons. The results of the experiment are shewn on the chart and in Table I. The greatly increased fall at the wound (*P*) is doubtless due to the more rapid evaporation in the wind. The effect in each of the branches not wounded in this experiment (*W* had been wounded in No. 1) is an arrest for a period closely corresponding with that of the fall at the wound.

A second fall commences in *P* at 11.35 and in *T* at 11.39; the recovery in each case beginning at 11.45. This is certainly an effect of cloud. At 11.33 the sun was partially obscured by a light cloud and remained so until 11.36. It was clouded again momentarily at 11.41, but before 11.45 was again shining brightly. The effects of this clouding are not shewn by *BB* which was not read between 11.30 and noon.

### No. 3. December 14.

Chart IV.

| | |
|---|---|
| Plant. | Euphorbia *A*. |
| Thermometers. | *W*, *T*, *P* all removed from the positions occupied on December 13, and replaced in fresh branches of the same plant. *W*, *T* were placed in the same furrow of the same branch; *P* in a neighbouring stem. |

Immediately after the 10 o'clock reading, the stem *P* was wounded in 4 of its 5 furrows by a close series of crossed shallow diagonal cuts. In each furrow the wounded area was about 2 inches long and extended horizontally from ridge to ridge. The middle of each wounded area was level with the point of insertion of the thermometer in the fifth furrow which was unwounded. The wounding was therefore much more extensive than in either of the previous day's experiments.

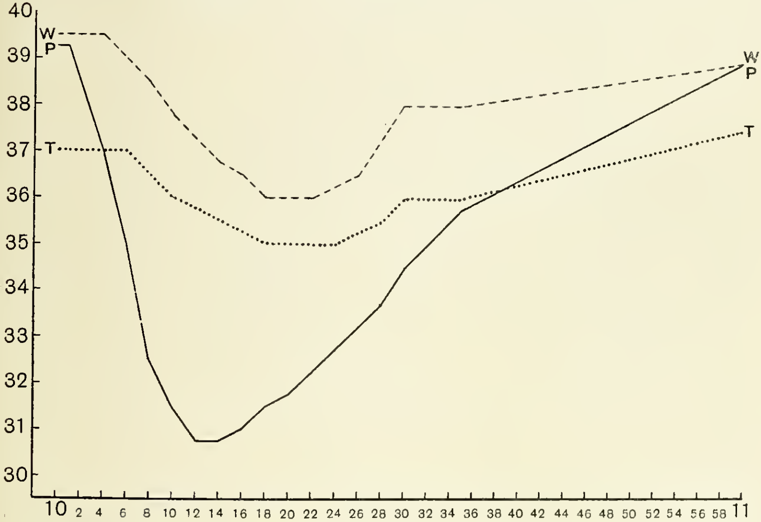
Between 9.30 and 10 the temperature of *P* rose from 35°·5 to 39°·25. In the same interval both *W* and *T* rose more rapidly than *P*. At 10.1 the temperature of *P* had not appreciably changed but immediately after the wounding it fell very rapidly—from 39°·25 to 30°·75 in 11 minutes. The other two thermometers, both being in the second branch under observation, shewed a smaller but nevertheless distinct fall and recovery.

The fall of temperature here is much greater and much more rapid than in the previous experiments. This, together with Experiment 5, leaves no doubt that the fall is definitely related to the extent of the wounded surface which would determine both the amount of the exuded latex and the expansion of the pith gases.

The thermometers *W* and *T* are here inserted in the same unwounded branch, *W* being 70 cm. above *T*. Assuming that the fall in the unwounded stem is sympathetic to that in the wounded stem, some influence must be transmitted through the plant from *P* to *W*. This influence must pass the bulb of the thermometer *T* before it reaches *W*. But *W* reacts more quickly than *T* and also undergoes a greater fall of temperature. On the hypothesis outlined above it is difficult to explain this except on the assumption that the walls of the pith cavity in which the bulb of *T* is enclosed were unusually rigid or, more probably, suffered less exhaustion of the fluids of their latex-system.

CHART IV. December 14.

Euphorbia *A* (Thermometers *W*, *T*, *P*).



The sun became slightly obscured during the early part of this experiment, and this no doubt added to the amount of the fall in each case. The recovery of *P* commenced 11 minutes and those of *W* and *T* 6 minutes before the clouds dispersed.

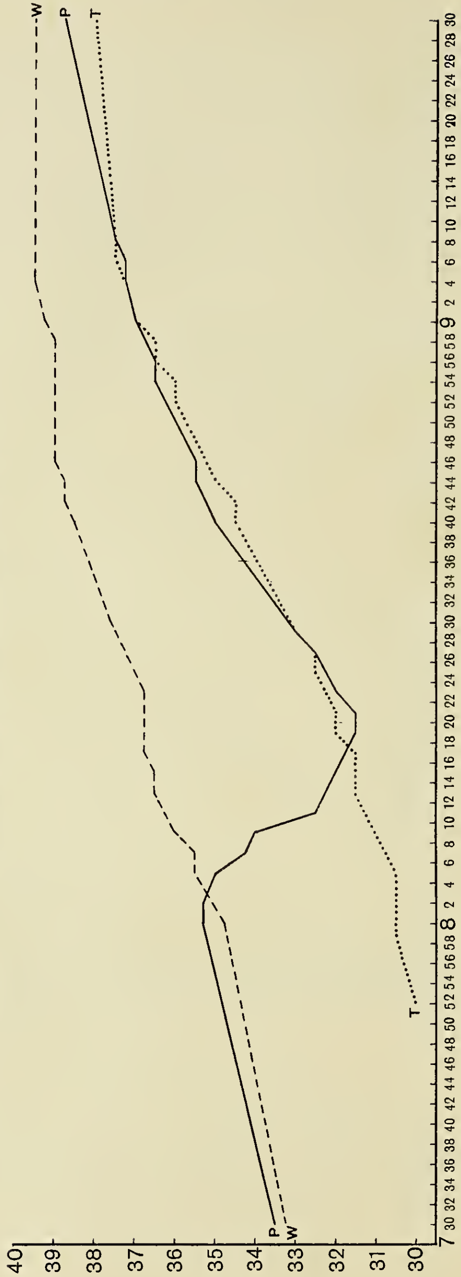
No. 4. December 14.

| | |
|---|---|
| Plant. | Euphorbia *A*. |
| Thermometers. | *W*, *T*, *P* all in same positions as in Experiment 3. |

Immediately after the 1 o'clock reading, all 5 furrows above and below the insertion of the thermometer *W* were wounded over an area extending

CHART V. December 15.

Euphorbia *A* (Thermometers *P*, *W*, *T*).



1 inch above and below the point of insertion of the thermometer. The wounding was completed in time to allow a reading to be taken at 1.2, when the temperature at the wound had already fallen 1°·5 C. The fall was greater than in the preceding experiment, but otherwise very similar. In the

Wounded branch at (*W*) ... total fall = 10°·75 C.
Unwounded „ at (*P*) ... „ „ = 4°·5 C.
Wounded „ at (*T*) ... „ „ = 3° C.

A striking character of the temperature curve of the wounded stem—very clearly shewn in this and in the preceding experiment—may here be noticed. The descending half of the curve is very much steeper than the ascending portion, the fall and the recovery not being due to complementary causes. And further, the fact that the descending curve is as steep in the first 3 minutes after wounding as in the succeeding 4 minutes, testifies to the importance of the first cause of cooling, assumed to be gas-expansion.

### No. 5. December 15.

### Chart V.

Plant. Euphorbia *A*.
Thermometers. *P*, *W*, *T* in the same positions as in Experiment 4.

At 8.2 two furrows of the stem *P* were wounded in the same manner and in the same places as at 10 A.M. on the previous day. The fall of temperature began promptly. The total fall was 3°·75 C., and the curve at the beginning of the descent was much more gradual than in the last two experiments. This is no doubt a direct consequence of the extensive wounding at the same place 22 hours earlier. The exhaustion of the latex caused a much reduced exudation in this experiment which means not only a reduced evaporation at the surface but also a smaller expansion of internal gases—perhaps even no expansion at all. If this is correct, then on the hypothesis stated above, the thermometers *W* and *T*, in a branch which in this experiment was not wounded, should shew little or no response. This is exactly what occurred. If a fall occurred in either of these thermometers it was less than 0°·25 C.

### No. 6 and 7. December 16.

Plant. Euphorbia *B*.
Thermometers. *Iv*, in a branch on the eastern side of the plant; *W*, 14 cm. below the apex of a branch on the western side of the plant.

At 9.35 A.M. the upper 7 cm. of the stem *W* were removed by a clean transverse cut, leaving the thermometer 7 cm. below the new apex. Two minutes later *W* shewed a fall of 0°·75 C. It then became stationary for

16 minutes. Then commenced a slow recovery which was interrupted by the infliction of a second wound at 10 A.M. (see No. 7). The thermometer *Iv* was not read between 9.30 and 9.37; in the interval it fell 1°·25 C. In the succeeding 2 minutes it fell a further 0°·25 C. after which it made a jerky recovery until 9.53, from thence remaining stationary until 10 o'clock. In the wounded stem *W* the cooling effects of evaporating latex are practically excluded. The fall of 0°·75 C. should therefore be due entirely to the sudden expansion of pith gases made possible by the removal of the top of the stem. If the whole fall in temperature recorded by *Iv* (viz. 1°·5 C.) is also due to gas-expansion we have the peculiar result which has been observed before, viz. that the effect at a greater distance from the wound is greater than at a nearer point (see No. 3).

The removal of the top of the stem of *W* had to some extent exhausted the available supply of latex. It seemed therefore that a second wound inflicted on *W* would throw further light upon the influence of surface-evaporation.

No. 7. Immediately after the 10 o'clock reading, the stem *W* was again wounded, this time in accordance with the practice of previous days, viz. the surface of the furrow containing the thermometer was scored by two crossed series of diagonal cuts for about 1 inch above and 1 inch below the position of the thermometer. At 10 o'clock *W* was still rising; *BB* was rising very rapidly. After the wounding very little latex exuded. The temperature of *W* shewed no fall but remained stationary for 14 minutes; in the 16 minutes immediately following it rose 1°·75 C. As in the preceding case, so here, the effect of the wound seems to have been felt to a greater extent in the unwounded branch *Iv* than in the one on which the wound was made. *Iv* was not read between 10 and 10.4, but in that interval its temperature fell 0°·25 C. and in the next 4 minutes it dropped a further 0°·25 C.

In this case, the causes which are assumed to bring about the total fall of temperature at the wound have been greatly reduced, one of them probably removed entirely. The mutilation of the stem *W* earlier in the day has probably reduced the gas-pressure in its vicinity to that of the atmosphere; expansion therefore does not occur as a result of the second wound. The partial exhaustion of the latex in the previous wounding prevents a copious outflow after the infliction of the second wound. So much as does exude is mainly drawn from the more distant parts of the plant—hence the fall, due to expansion, at *Iv* and the arrest, due to surface-evaporation, at *W*.

### No. 8. December 17.

| | |
|---|---|
| Plant. | Euphorbia *B*. |
| Thermometers. | *Iv* and *W* in the same positions as in Experiment 7. |

The thermometers were in the same positions as on December 16.

Immediately after 10.30, the branch of the Euphorbia *B* was wounded in the usual manner on two furrows, one of which contained the thermometer (*Iv*). The results are shewn in Table I. The main point of interest is that no response was observed in the unwounded stem (*W*). As has been suggested above, the explanation is no doubt to be found in the fact that *W* had been both wounded and mutilated on the previous day, whereby its pith gases were reduced to atmospheric pressure. It therefore furnishes an interesting confirmation of the hypothesis that the fall in temperature at a distance from the wound is due entirely to gas-expansion.

No. 9. December 20.

| | |
|---|---|
| Plants. | Aloe *A* (wounded).<br>Aloe *B* (control). |
| Thermometers. | *T* (in Aloe *A*), *W* (in Aloe *B*). |

Immediately after the midday reading, the stem of Aloe *A* was wounded. The bark was removed from an incomplete ring 12 inches high, so situated that the level of the insertion of the thermometer bisected its height. The wound included more than three-quarters of the circumference of the stem: the insertion of the thermometer was in the unwounded part of the ring. The wound exposed the secondary tissues of the wood which were wet to the touch. The operation of wounding was completed at 12.9.

For 51 minutes after the completion of the wounding (i.e. until 1 P.M.) the curve *T* was not affected but continued to ascend slightly more rapidly than *W*. After 1 o'clock a marked divergence commenced, for while *W* continued to rise, *T* began a steady fall. Evaporation began as soon as the bark was removed, and its amount was so great that the surface very quickly felt cold when touched. The time which elapsed between the infliction of the wound and the first response by the centrally situated thermometer-bulb was sufficient to allow of the view that the fall in the internal temperature is due to conduction between the interior and the surface. *T* fell fairly steadily till 3.30. After 3.30 the fall was checked and a slight rise occurred between 4.30 and 5.30. After 6 o'clock the fall began again and was probably continued through the night. *W* meantime rose continually until it reached a maximum at 6 o'clock and maintained it for half an hour. On December 18 (Chart II) *W* remained constant at its maximum temperature from 4.30 until 6; *T* from 5.30 until 6. This partial recovery of *T* between 3.30 and 6 may therefore be regarded as a natural result of the external temperature conditions prevailing in its immediate locality. Its recovery also followed more or less closely upon the cessation of rapid evaporation at the wounded surface, for it was noted at 4 P.M. that "the exposed wood now feels quite dry." The arrest of the fall at 3.30 therefore probably indicates that equilibrium had been established between the absorption of heat from without and the loss of heat by surface-evaporation.

The difference between the temperatures of *W* and *T* at their maxima on December 18, i.e. before *T* was wounded, was 2° C. After wounding, on December 20, they differed at their maxima by 9°·75 C., the greater difference in this case being apparently entirely due to the consequences of wounding.

On the following morning (December 21) at 5 o'clock, *T* stood at 19°·8 C. while *W* read 25°·5. *T* continued to fall until 9 A.M. to 19°·4, *W* at the same time reading 27°·2. After 9 o'clock both rose slowly, *W* faster than *T*. At 2.45 P.M. when the last readings were taken, *T* stood at 28°·5, *W* at 37°·8.

The effects of the wounding of *T* were therefore manifested very slowly and for a long period and the recovery was very gradual. Indeed, but for the fact that many years before, Aloe *B* had evidently received a more severe wound near the base of the trunk (see Photograph 3), it might have been doubted whether complete recovery was possible. In this case, however, a partial callus had formed, and to all appearance the tree was as vigorous as if it had never been wounded.

A brief visit was paid to the locality on January 22, 1913. The wood exposed by the wound made on December 20 was dry and easily powdered. The leaves were shrivelled and most of them hanging and the plant certainly looked as if it was unlikely to survive. Rain had fallen in the meanwhile and there was no reason to suppose that its appearance was the natural result of prolonged drought.

## 5. Discussion.

In the Aloe, as in the Euphorbia, the infliction of a surface wound is followed by a lowering of the internal temperature. In the former case, the fall commences after a considerable interval, it is slow and it continues for some hours when the wound is large. It is without doubt a simple effect of evaporation at the surface and conduction through the water-laden tissues of the xylem.

In the Euphorbia the effects of surface-wounding are much less simple. They are complicated by the presence of large reservoirs of gas in the pith, by the copious outflow of latex and by the rapid formation of a pellicle of rubber over the surface of the wound. Here the fall in the internal temperature is due only partially to surface-evaporation; it is considerably enhanced by another cause which acts more quickly and over a much greater distance than surface-evaporation. This cause is believed to be the expansion of the gases imprisoned in the pith.

The exudation of latex[1] implies an internal pressure higher than that of

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[1] This occurs even at the time of minimum air and internal temperatures.

the atmosphere. The infliction of a wound therefore lowers the internal pressure. Since the ramifications of the latex-system extend into the tissue-diaphragms of the pith, the pressure of the gases confined by these diaphragms
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a column of dry air.
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ratio of the two specific heats, then the relation

$$Tv^{\gamma-1} = \text{constant}.$$

vhich an initial volume $v$ at temperature 40° C.
cally, in order that the temperature may fall 4° C.,
hen

$$\frac{(xV)^{\gamma-1}}{v^{\gamma-1}} = \frac{313}{309}.$$

value for air) we find $x \fallingdotseq 1{\cdot}032$, the volume must
ately 3·2 %; in order to produce a fall of 1° viz.
rease must be slightly over 1 %.
pressure $p$ and temperature $T$ for an adiabatic

$$\frac{p^{\gamma-1}}{T^{\gamma}} = \text{constant},$$

ll of 4° C. from an original temperature of 40° C.

$$\frac{(xp)^{\gamma-1}}{p^{\gamma-1}} = \frac{309^{\gamma}}{313^{\gamma}},$$

$\fallingdotseq 0{\cdot}956$ for $\gamma = 1{\cdot}4$,
ill be approximately 4·4 %; for a fall of a degree
se in pressure will be approximately 1·1 %.
l of temperature of 4° C.[1] of such a gas at 40° C.

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l in an unwounded stem was 4°·5 C. (see Table I).

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*Correction*

*Annals of the Bolus Herbarium*, Vol. I. p. 58, ll. 10, 11 from bottom of page

*omit* "of the xylem."

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[1] This occurs even at the time of minimum air an

With regard to this point, my colleague Dr J. C. Beattie has kindly made the following calculations for a column of dry air.

In the case of an adiabatic change of volume let $v$ be the volume, $T$ the absolute temperature, $\gamma$ the ratio of the two specific heats, then the relation between $v$ and $T$ is given by

$$Tv^{\gamma-1} = \text{constant}.$$

To find the volume to which an initial volume $v$ at temperature 40° C. will have to expand adiabatically, in order that the temperature may fall 4° C., let $xV$ be the new volume, then

$$\frac{(xV)^{\gamma-1}}{v^{\gamma-1}} = \frac{313}{309}.$$

Whence for $\gamma = 1{\cdot}4$ (the value for air) we find $x \fallingdotseq 1{\cdot}032$, the volume must therefore increase approximately 3·2 %; in order to produce a fall of 1° viz. from 40° C. to 39° C. the increase must be slightly over 1 %.

The equation connecting pressure $p$ and temperature $T$ for an adiabatic change is

$$\frac{p^{\gamma-1}}{T^{\gamma}} = \text{constant},$$

the new pressure $xp$ for a fall of 4° C. from an original temperature of 40° C. is therefore given by

$$\frac{(xp)^{\gamma-1}}{p^{\gamma-1}} = \frac{309^{\gamma}}{313^{\gamma}},$$

whence $x \fallingdotseq 0{\cdot}956$ for $\gamma = 1{\cdot}4$,

or the decrease in pressure will be approximately 4·4 %; for a fall of a degree from 40° to 39° C. the decrease in pressure will be approximately 1·1 %.

It appears then that a fall of temperature of 4° C.[1] of such a gas at 40° C.

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[1] The greatest observed fall in an unwounded stem was 4°·5 C. (see Table I).

will be produced by an adiabatic increase in volume of approximately 3·2 % of the total volume at 40° C. Since the air is not dry but contains an unknown quantity of water-vapour, the expansion will be very slightly greater than 3·2 %. In the absence of any, even approximate, estimate of the volume of gas concerned and of the latex exuding, it is impossible to be certain whether a wound would make it possible for a 3–4 % increase in volume to occur. All that can be said is that the outflow of latex is so great that there seems to be no difficulty in regarding a wound 5 square inches in extent (Exp. 4) as sufficient to cause the expansion necessary to reduce the temperature by the amount observed.

The effects of expansion in the neighbourhood of the wound must be almost instantaneous. This will not be the case farther away, partly because the impulse will be delayed by the diaphragms, and also because, as long as the latex flows, pressure in more distant parts of the branch from which it is being drawn will continue to fall. Therefore the expansion and consequent fall in temperature go on till the outflow of latex ceases; its effects on the temperature of distant parts of the plant will be apparent therefore for some minutes; at the wound itself they are quickly masked by the cooling effects of evaporation. Confirmation of this is probably seen in Exp. 6. Here the only wound inflicted was made by removing the top of the stem. The effects of evaporation are excluded and the exudation of latex was small and of very short duration. The change in internal pressure was therefore effected much more rapidly than in the other experiments. To be correlated with this are the facts that in this experiment the falls in temperature in the wounded and unwounded branches are *completed* in 2 minutes and 4 minutes respectively.

If the hypothesis here adopted be correct, some interesting biological conclusions are indicated. Whatever may be the absolute internal pressure of the confined gases, it must vary by as much as $\frac{1}{10}$ of an atmosphere from one part of the day to the other, and this during the vegetative season. The external form of the branch must be slightly different at the periods of low and high pressures and when the volume of the gas is large it is not impossible that this difference of form may be such as to exercise a controlling effect upon the rate of transpiration during the hotter part of the day. Oscillation between high and low intercellular pressures (amounting to as much as $\frac{1}{10}$ atmosphere) can hardly fail to influence the growth of the tissues, either in the rate or direction of cell-division or elongation. That this influence has not been such as to produce any marked effect upon the permanent form of the branch probably follows from the fact that other Euphorbias whose branches resemble these in outward form are without large air-containing intercellular spaces in the pith[1].

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[1] Worsdell, *l.c.*

The presence of gas at comparatively high pressure in the pith must increase the rigidity of the stem as a whole. This can hardly be without importance in a massive plant with little mechanical tissue, growing in unsheltered localities swept, with almost daily regularity, by winds which frequently assume the proportions of a gale; and further, the rigidity increases as the temperature rises and will reach a maximum in the afternoon when the winds usually spring up.

But it is improbable that so remarkable a structure, apparently of very exceptional occurrence in plants of this habit, has no other part to play in the economy of the plant. The composition of the gas is unknown; it may be assumed to be air containing inconstant proportions of Oxygen and Carbon dioxide, and it is probably of importance in providing a reservoir with which free gaseous exchange can take place at times when the communication of the intercellular system with the external air is reduced or perhaps entirely cut off.

## 6. Summary and Conclusions.

1. The observations of internal temperatures were made on the stems of *Euphorbia virosa* and *Aloe dichotoma*, at 4200 ft. s.m., on the western flanks of the Great Karasberg Range in Great Namaqualand.

2. In the Euphorbia the pith region occupies about two-thirds of the diameter of the fluted columnar stems; and contains very numerous lysigenous "air"-cavities of various sizes[1] (see Photograph 2); these spaces are separated by diaphragms of medullary tissue containing branches of the latex-system, never very thick, frequently very thin; they occur through the whole length of the pith except at the extreme apex of the branch. The short main stem from which the branches arise has the same form when young as the branches which it bears later.

3. The thickness of the Aloe stem is mainly made up of secondary wood, soft water-storing tissue, with small but numerous and uniformly distributed intercellular air-spaces[1].

4. The Euphorbia responds more quickly than the Aloe to changes in the external temperature-conditions, and attains higher maxima.

5. In each case the internal temperature begins to rise very slowly a few minutes before the plant is touched by the rising sun; when fully illuminated the temperature rises much more rapidly.

6. The Euphorbia when growing in the open reaches its maximum temperature on unclouded days about 2 P.M. The time "lag" was not determined but it is short, certainly less than 30 minutes, probably very much less.

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[1] Worsdell, *l.c.*

7. The internal temperature of the Aloe stem continues to rise for some hours after the meteorological maxima are past. Its fall does not usually commence until about sunset. This, however, in the two cases investigated, is partly due to the situation of the two plants—on a steep hillside, facing west.

8. The maxima and daily ranges recorded are tabulated in Table II.

9. When the Euphorbia is wounded in the neighbourhood of a thermometer, by scraping the epidermis or by a series of shallow incisions, deep enough to cause a flow of latex, the internal temperature falls suddenly.

10. The fall commences within less than 2 minutes of the infliction of the wound. The steepness of the curve in these 2 minutes seems to indicate that the wounding and the initial drop in temperature are practically simultaneous.

11. The extent of the fall in temperature does not appear to be related to the length of period during which it continues, but it is in some degree dependent upon the area of the surface wounded. This is shewn in Table I.

12. From §§ 10 and 11 it may be concluded that the fall in temperature in the wounded stem is due to at least two distinct causes, viz.

*a.* A first cause which acts within 2 minutes of wounding, probably almost instantaneously.

*b.* A second cause which comes into action later and continues to act for a longer time. This, almost certainly, is the cooling effect of the evaporation of exuded latex at the surface. The evidence for this conclusion is mainly

$\alpha$. The fall in temperature ceases very shortly after the cessation of evaporation—i.e. after the formation of a rubber-pellicle over the wound.

$\beta$. The extent of the fall in temperature is to some extent related to the area wounded—i.e. to the amount of exuded latex.

13. The unwounded branches also usually shew either a distinct fall or an arrest of the normal rise of internal temperature, when another branch of the same plant is wounded. This fall or arrest commences within a very short interval of the wounding. The amount of the fall of temperature in the unwounded branch is usually less than in the one that is wounded (see Table I).

14. The available evidence indicates that the cause of the fall of temperature in the unwounded branch is identical with the first of the two causes of the fall at the wound, viz. the expansion of the pith gases due to the withdrawal of latex.

15. A similar lowering of the internal temperature of the stem of *Aloe dichotoma* follows the exposure of the secondary wood by a surface wound. This appears to be due entirely to surface-evaporation.

16. That the coagulation of caoutchouc on the surface of a wound in a laticiferous plant must be of some importance in wound-healing is evident[1]. A comparison of the immediate effects of wounding in the Euphorbia and the Aloe emphasises this importance. The rapid recovery in the internal temperature in the former and the very slow recovery in the latter are probably due, in the main or entirely, to the fact that the wound is sealed by coagulated latex in the one and not in the other.

I desire to acknowledge the courtesy of His Excellency the Governor and the Officers of the Government of German South-West Africa in facilitating the journey and the work of the Expedition in every possible way. The Expedition also received invaluable assistance from Mr E. H. W. Müller, H.B.M. Consul at Lüderitzbucht and from Mr A. T. Scotland, General Manager of the South African Territories Company. I am further indebted to Dr F. F. Blackman, F.R.S., for kindly allowing me to consult him with regard to the difficulties experienced in carrying out the preliminary observations in the Orange River Expedition of 1910–11 and for his advice on points arising in the present investigation; and to Miss H. J. Davison, B.A., who has drawn the charts.

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[1] Pfeffer, *l.c.* I. 582.

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## TABLE I.

*Euphorbia virosa.*

Summary of Results of Wounding Experiments.

| Exp. | Time of Day | Area wounded (approximate) | Wounded Branch | | | Unwounded Branches | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Fall | Time between wounding and beginning of recovery | Con-dition[1] | Total Fall | | Time between wounding and beginning of recovery | | Condition[1] | |
| 1 | 9.10 A.M. | 1 sq. in. | 1°·5 C. | 15 mins. | *N W* | T<br>0 | P<br>0°·5 C. | T<br>20 mins. or more | P<br>15 mins. | T<br>*N W* | P<br>*N W* |
| 2 | 11.5 A.M. | 1 sq. in. | 3°·25 C. | 20 mins. | *N W* | T<br>0 | W<br>0 | T<br>16 mins. or more | W<br>14 mins. or more | T<br>*N W* | W<br>*W* |
| 3 | 10 A.M. | 4 sq. in. | 8°·5 C. | 13 mins. | *N W* | T<br>2°·0 C. | W<br>3°·5 C. | T<br>18 mins. | W<br>18 mins. | T<br>*N W* | W<br>*N W* |
| 4 | 1 P.M. | 5 sq. in. | 10°·75 C. | 14 mins. | *N W* | T<br>3°·0 C. | P<br>4°·5 C. | | | T<br>*Br* | P<br>*W* |
| 5 | 8.2 A.M. | 2 sq. in. | 3°·75 C. | 19 mins. | *W* | No response observed | | | | T<br>*Br* | W<br>*W* |
| 6 | 9.30 A.M. | Top of stem cut off | 0°·75 C. | 18 mins. | *N W* | 1°·5 C.? | | 4 mins. or less | | *N W* | |
| 7 | 10 A.M. | 1 sq. in. | 0 | 14 mins. | *M* | 0°·5 C. | | 10 mins. | | *N W* | |
| 8 | 10.30 A.M. | 2 sq. in. | 4°·25 C. | 19 mins. | *N W* | No response observed | | | | *M*, *W* | |

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[1] In these columns the following symbols are used:—*N W*=not wounded before; *W*=wounded in a previous experiment; *Br*=wounded in another part of same branch in a previous experiment; *M*=mutilated in a previous experiment.

## TABLE II.

Shewing the observed ranges of shade and internal temperatures[1].

| Date | Screen Maximum | Screen Minimum | Range | Internal Maximum Recorded | Internal Minimum Recorded | Range | Plant |
|---|---|---|---|---|---|---|---|
| Dec. 12 | 98°·5 F. | 75°·5 F. | 12°·7 C. | 51°·25 C. | 24°·5 C. | 26°·75 C. | Euphorbia A |
| Dec. 13 | 99°·5 F. | 75°·0 F. | 13°·6 C. | 51°·5 C. | 24° C. | 27°·5 C. | Euphorbia A |
| Dec. 14 | 94°·0 F. | 69°·0 F. | 13°·8 C. | 42°·5 C. | 21° C. | 21°·5 C. | Euphorbia A |
| Dec. 15 | 97°·5 F. | 75°·5 F. | 12°·2 C. | 45°·0 C. | 25°·5 C. | 19°·5 C. | Euphorbia A |
| | | | | 45°·0 C. | not recorded | — | Euphorbia B |
| Dec. 16 | 95°·5 F. | 74°·5 F. | 11°·6 C. | 38°·5 C. | 24°·5 C. | 14° C. | Euphorbia A |
| | | | | 39°·5 C. | 24°·0 C. | 15°·5 C. | Euphorbia B |
| | | | | 38°·0 C. | 24°·75 C. | 13°·25 C. | Aloe A |
| Dec. 17 | 97°·5 F. | 71°·5 F. | 14°·4 C. | 45°·25 C. | 20°·0 C. | 25°·25 C. | Euphorbia A |
| | | | | 47°·0 C. | 20°·75 C. | 26°·25 C. | Euphorbia B |
| | | | | 38°·0 C. | 22°·5 C. | 15°·5 C. | Aloe A |
| Dec. 18 | 91°·0 F. | 69°·0 F. | 12°·2 C. | 36°·0 C. | 22°·5 C. | 13°·5 C. | Euphorbia B |
| | | | | 42°·75 C. | 22°·75 C. | 20°·0 C. | Euphorbia C |
| | | | | 33°·5 C. | 22°·0 C. | 13°·5 C. | Aloe A |
| | | | | 35°·5 C. | not recorded | — | Aloe B |
| Dec. 19 | 94°·0 F. | 70°·0 F. | 13°·3 C. | 40°·5 C. | 20°·0 C. | 20°·5 C. | Euphorbia B |
| | | | | 45°·75 C. | 21°·0 C. | 24°·75 C. | Euphorbia C |
| | | | | 36°·5 C. | 21°·25 C. | 15°·25 C. | Aloe A |
| | | | | 38°·5 C. | 22°·5 C. | 16°·0 C. | Aloe B |
| Dec. 20 | 93°·0 F. | 68°·5 F. | 13°·6 C. | 41°·0 C. | 21°·0 C. | 20°·0 C. | Euphorbia B |
| | | | | 46°·0 C. | 21°·75 C. | 24°·25 C. | Euphorbia C |
| | | | | 38°·5 C. | 22°·75 C. | 15°·25 C. | Aloe B |

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[1] Although observations were not made through the night, there is little doubt that the minimum is reached a few minutes before sunrise. It is probable that the true maximum in each case was slightly higher than that recorded.

## TABLE III.

*Wasserfall Alt.* *December,* 1912.

Summary of Meteorological Observations.

| Date | | Maximum | Minimum | Shade | "Grass" Minimum | Wet Bulb | Dry Bulb |
|---|---|---|---|---|---|---|---|
| Dec. 10 | 8.30 A.M. | | 68° F. | 31°·4 C. | | 13°·8 C. | 30°·2 C. |
| | 8.30 P.M. | 97°·5 F. | | 24°·6 C. | | 11°·8 C. | 24°·8 C. |
| Dec. 11 | 8.30 A.M. | | 63°·5 F. | 22°·6 C. | | 9°·2 C. | 22°·0 C. |
| | 8.30 P.M. | 93°·5 F. | | 29°·6 C. | | 11°·2 C. | 28°·2 C. |
| Dec. 12 | 8.30 A.M. | | 75°·5 F. | 30°·6 C. | 69°·5 F. | 14°·2 C. | 30°·3 C. |
| | 8.30 P.M. | 98°·5 F. | | 31°·6 C. | | 13°·8 C. | 31°·6 C. |
| Dec. 13 | 8.30 A.M. | | 75°·0 F. | 27°·9 C. | 73°·0 F. | 16°·5 C. | 28°·0 C. |
| | 8.30 P.M. | 99°·5 F. | | 26°·9 C. | | 15°·0 C. | 26°·0 C. |
| Dec. 14 | 8.30 A.M. | | 69°·0 F. | 27°·4 C. | 68°·5 F. | 14°·8 C. | 27°·7 C. |
| | 8 P.M. | 94°·0 F. | | 27°·9 C. | | 15°·0 C. | 28°·2 C. |
| Dec. 15 | 8.30 A.M. | | 75°·5 F. | 85°·0 F. | 73°·0 F. | 16°·6 C. | 27°·0 C. |
| | 8.30 P.M. | 97°·5 F. | | 85°·0 F. | | 15°·2 C. | 29°·6 C. |
| Dec. 16 | 8.30 A.M. | | 74°·5 F. | 84°·0 F. | 74°·0 F. | 16°·2 C. | 28°·5 C. |
| | 8.15 P.M. | 95°·5 F. | | 81°·5 F. | | 16°·2 C. | 27°·4 C. |
| Dec. 17 | 10 A.M. | | 71°·5 F. | 88°·5 F. | 65°·5 F. | 15°·5 C. | 30°·8 C. |
| | 6.30 P.M. | 97°·5 F. | | 82°·0 F. | | 15°·6 C. | 27°·6 C. |
| Dec. 18 | 8.30 A.M. | | 69°·0 F. | 81°·0 F. | 65°·0 F. | 15°·4 C. | 26°·7 C. |
| | 8 P.M. | 91°·0 F. | | 82°·5 F. | | 15°·8 C. | 28°·0 C. |
| Dec. 19 | A.M. | | 70°·0 F. | | | | |
| | 8.15 P.M. | 94°·0 F. | | 81°·0 F. | | 12°·8 C. | 27°·4 C. |
| Dec. 20 | 8.30 A.M. | | 68°·5 F. | 77°·0 F. | 67°·5 F. | 12°·2 C. | 25°·0 C. |
| | 8.30 P.M. | 93°·0 F. | | 82°·5 F. | | 12°·6 C. | 28°·4 C. |

# ON SOME POINTS IN THE STEM-ANATOMY OF *EUPHORBIA VIROSA* AND *ALOE DICHOTOMA*[1]

By W. C. WORSDELL

I am indebted to Prof. H. H. W. Pearson for placing at my disposal material of the stems of a candelabra-like Euphorbia and of the arborescent *Aloe dichotoma* Linn., both growing at an altitude of about 4000 ft. in the region of the Karasberg in Namaqualand (German South-West Africa). I was requested to try and trace the origin of the conspicuous air-cavities which occur in the pith of the Euphorbia and in the secondary wood of the Aloe.

The ground-tissue of the stem in succulent plants as a general rule consists of cells which are often water-storing and are usually compactly grouped with either no, or very small, intercellular air-spaces. Such, for example, is the state of affairs in the pith of the stem of *Euphorbia Caput Medusae* Linn., *Aloe africana* Mill., *Kleinia*, *Stapelia*, which I have examined. The air-spaces are, in all ordinary cases, just large enough to enable the cells to carry on their necessary respiratory functions. On the other hand, it would appear to be a phenomenon of great rarity for one and the same tissue to act both as a water-storing and an air-storing reservoir. Such a case, however, is afforded by the succulent stem-tubers of the myrmecophilous plants *Myrmecodia* and *Hydnophytum*[2], whose water-storing tissue is permeated by large air-cavities, with cork-lined internal surfaces which later become adapted to serve as the domicile of ants.

There are, however, other species of arborescent Euphorbias in which the air-spaces occur. I have seen a living stem of *E. neglecta* N. E. Br. possessing very large pith-cavities, of *E. procumbens* Miller, with fairly large ones, of *E. Dregeana* E. Meyer, with very numerous small cavities in the pith, and of *E. canariensis* with indications thereof. I have also seen these pith-cavities very well-developed in dried material of *E. Cooperi* N. E. Br., *E. grandicornis* Goebel, and in a form doubtfully referable to *E. triangularis*; also in some individuals, but not in others, of *E. meloformis* Ait[3]. In other species of succulent Euphorbias the cavities are entirely absent.

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[1] *Percy Sladen Memorial Expeditions in South-West Africa, Report No.* 27.

[2] Cf. G. Haberlandt: *Physiologische Pflanzenanatomie*; 2nd ed. 1896, p. 349.

[3] I am indebted to Mr N. E. Brown for shewing me herbarium-specimens of these species at Kew.

I will now proceed to describe some points of the structure of the Euphorbia and Aloe from Namaqualand above-mentioned.

### *Euphorbia virosa* Willd.

The numerous elongated branches of this candelabra-like type spring from near the base of the much thicker main stem which in a young state is lateral[1].

In a section, either transverse or radial, through the stem it can be seen that the pith is traversed by very large air-cavities which are really continuous throughout the entire tissue. The size, shape, and distribution of these cavities, as seen in radial longitudinal and transverse sections of the pith, can be at once ascertained by reference to Photograph 2[2] and Figs. 2, 4, 5. Such a medullary structure is surely unheard of in any Euphorbia-stem hitherto investigated[3]!

I may now refer to the mode of origin of these remarkable air-spaces in the species under discussion.

In the apical region of the pith there is no sign of them whatsoever. A little lower down they begin to arise in the form of larger and smaller, lighter or more transparent areas, as seen in transverse section (Fig. 1, *as*).

The *ordinary* intercellular air-spaces in the pith are exceedingly small. I could discover absolutely no indication that the big air-cavities arose schizogenously in the first instance by the enlargement of the intercellular spaces. On the other hand, it is clear that we must attribute to these air-cavities a *lysigenous* origin, for in no other way can the appearance of the transparent areas in the midst of the dense medullary tissue be explained. Moreover, I have ascertained by direct observation that the cavities arise by the breaking down of groups of cells at various points throughout the pith. The walls of the cells are dissolved probably by fermentative action, for there is no evidence of their mucilaginous degeneration. Fig. 3 shews the formation of one of the small cavities such as are seen in Fig. 1; its lysigenous mode of origin is fairly apparent. The larger cavities arise by the progressive destruction of the cells at the periphery. All the cells have protoplasmic contents; their walls are not perforated by the large circular pits which are so characteristic of the cells of some types of water-storing tissue.

The mode of origin of these air-cavities is thus explained. It is, however, quite another matter to determine the function which they subserve, and this feat is quite beyond my powers.

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[1] Pearson, *Ann. Bol. Herb.* I (1914), Photograph 1.

[2] Pearson, *l.c.*

[3] Cf. Warming: *The Œcology of Plants*:—"True water-tissue is thin-walled, contains water but no chlorophyll, is devoid of intercellular spaces (as no gaseous exchange occurs in it) and its cells are usually very large."

As the presence of the large amount of air in the pith may have a bearing on the assimilatory and respiratory functions of the plant, I may just refer to the distribution of the stomata. The cortex is relatively narrow and contains green-cells in abundance; the stomata are only slightly depressed, consist of the two guard-cells and conspicuous and very clear-looking subsidiary cells, and occur both in the furrows and on the surface of the spine-bearing ridges.

## *Aloe dichotoma* Linn.

This plant grows in the same locality and habitat as the Euphorbia just described and is of arborescent habit[1].

Prof. Pearson asked me to determine the mode of origin of the peculiar large air-cavities which occur in the secondary tissue of the stem which, as in the case of those in the Euphorbia-stem, seemed a somewhat astounding feature in a thorough-going succulent.

The cambium occurs immediately within the very narrow cortex at the extreme periphery of the stem. The primary tissue of the central cylinder occupies an area at the solid centre of the stem of relatively very small diameter. The great bulk of the whole internal area of the stem is occupied by the secondary aërated tissue which is traversed at intervals by narrow zones of closely-fitting stone-cells which superficially resemble the successive vascular rings in a Dicotyledonous stem with extrafascicular cylinders. The vascular bundles and numerous sacs containing raphides-crystals, are scattered amongst the often somewhat radially-elongated cells of the secondary ground-tissue. The youngest portion of this tissue, situated outside the outermost zone of stone-cells, forms a fairly compact mass of cells, with small intercellular air-spaces at their corners.

As to the mode of origin of the lacunae in the secondary ground-tissue, it was quite easy to determine that they arise *schizogenously*. The cells, once they are formed by the cambium, do not undergo division by means of radial walls. Hence, as the stem increases in girth owing to the growth of the cortical tissue, the tension set up in the tangential direction causes a partial splitting-apart of many of the rows of secondary ground-tissue cells situated between the zones of stone-cells (Fig. 8). The result is a system of wide meshes of air-cavities separated by strands, many cells thick, of narrow elongated cells, in which the vascular bundles and crystal-sacs are imbedded. Lindinger[2] gives a detailed account of the anatomy of an *adult* stem of this species which had been grown in the Hamburg Botanic Gardens. As he never once refers to the air-cavities of the secondary tissue, I must conclude, in view of their extreme conspicuousness in the stem which I examined, that his specimen was, for some strange reason, devoid of them!

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[1] Pearson, *l.c.* Photograph 3.

[2] Lindinger: "Ueber die Struktur von Aloe dichotoma" (*Verh. Naturw. Ver. Hamburg*, ser. 3, vol. XVI, 1909, pp. 96–8).

The air-cavities of the *secondary* tissues being thus accounted for, I must next direct attention to those of the *primary* tissues.

If the ground-tissue of the young stem, in a region not remote from the apex, be examined, it will be seen that the cells are much rounded off, leaving very numerous intercellular air-spaces between them, as seen in transverse section. The cells are of the typical water-storing type with large circular pits in their walls. As seen in Fig. 6, some of the air-spaces are of considerable size, formed by a more complete separation of the walls of a number of cells.

At a level more remote from the apex, the water-storing tissue is seen to be studded with much larger air-cavities, and evidently of quite a different type (Fig. 7). They have arisen by the *lysigenous* method, by the dissolution of the walls of groups of cells, and become progressively larger as the stem increases in age, until they form, in the central primary tissue of the stem, a network of air-spaces, very comparable, when viewed macroscopically, with that in the more external secondary tissue.

It is probable that the larger among the schizogenous air-spaces of the younger tissues serve as the nucleus for the formation of the air-spaces of the older parts of the primary tissue, which is a point of difference from what obtains in the case of the Euphorbia above described.

Thus we see that there are two distinct modes of origin for the air-cavities in the stem of this species of Aloe: (1) a schizogenous mode for those of the secondary tissue and for the earlier stages of those of the primary tissue; and (2) a lysigenous mode for the later stages of the latter.

In explanation of the presence of the air-cavities in this plant, all I can say is that we have to deal with a special kind of aërating tissue serving some necessary purpose in the economy of this species and of the others in which it occurs.

I can discover no account in the literature of any such tissue in the stem of Aloe. On the other hand I have not as yet had the opportunity of examining the mature stem of any other species.

### *Summary.*

1. The pith of the stem of the succulent *Euphorbia virosa* Willd. from Namaqualand, as also of other species mentioned, is permeated by air-cavities of very large dimensions.
2. These cavities have a lysigenous mode of origin.
3. They probably serve as a special type of aërating channels.

4. The water-storing tissue of the primary parts of the stem of *Aloe dichotoma* Linn. from Namaqualand is traversed by a network of intercellular spaces which are formed, in the first place schizogenously, but for the most part according to the lysigenous method.

5. The air-cavities in the secondary ground-tissue are formed schizogenously as a result of tensions set up during the increase of girth of the stem.

6. In the Aloe-stem there are thus two distinct systems of aërating tissue.

7. In both plants we see examples of a combination, *within one and the same tissue,* of the two functions of water-storing and of air-storing.

# FLOWERING PLANTS AND FERNS COLLECTED ON THE GREAT KARASBERG BY THE PERCY SLADEN MEMORIAL EXPEDITION, 1912–1913[1]

BY F. BOLUS, L. BOLUS AND R. GLOVER

(*Continued from page* 19)

## COMPOSITAE

Pteronia cylindracea, DC. *Western and Central Karasberg.* High plateau between Wasserfall and Krai Kluft, 8251.

Felicia muricata, Nees. *Central and Eastern Karasberg.* Summit of Scharfenstein, 7915. Narudas Süd Ravine, 8125.

Felicia Burkei, L. Bolus (= Aster Burkei, Harv.). *Eastern Karasberg.* Sandy plains, Narudas Süd, 7914.

Felicia gariepina, L. Bolus (= Nidorella gariepina, DC.). *Western, Central and Eastern Karasberg.* Sandy locality in granite plateau between Dassiefontein and Noachabeb, 7929. Middle and upper slopes, Scharfenstein, 7943. Eastern granite slopes, Narudas Süd, 7942.

Nidorella resedaefolia, DC., var. β, rapunculoides. *Central and Eastern Karasberg.* Near water edge, Krai Kluft, 7928. River bed, 8282. Second outspan between Krai Kluft and Narudas Süd, river bed, 8094.

Nidorella punctulata, DC. *Central Karasberg.* Among boulders, Krai Kluft Ravine, 8204.

Chrysocoma tenuifolia, Berg. *Central Karasberg.* Summit of Scharfenstein, 7913.

Helichrysum Zeyheri, Less. *Eastern Karasberg.* Granite foothills, Narudas Süd, 7912.

Iphiona polygalifolia, Benth. and Hook. f. *Western and Eastern Karasberg.* Dry sandy places in granite plateau between Dassiefontein and Noachabeb, 7930. Stony plains, Narudas Süd, 8313.

Iphiona pinnatisecta, Sp. Moore. *Western Karasberg.* Wasserfall Ravine, 8070.

Pegolettia oxyodonta, DC. *Western and Eastern Karasberg.* Stream slopes (quartz) on granite plateau between Dassiefontein and Noachabeb, 7931. Sandy plains, Narudas Süd, 7932.

Pentatrichia petrosa, Klatt. *Western and Central Karasberg.* Rocky sides of ravine, Wasserfall, 8082. Among rocks near head of ravine, Krai Kluft, 8202.

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[1] *Percy Sladen Memorial Expeditions in South-West Africa, Report No.* 70 (*continued*).

Geigeria passerinoides, Harv. *Western Karasberg.* Sandy plains north-east of Noachabeb, 7933.

Geigeria pectidea, Harv. *Western, Central and Eastern Karasberg.* Sandy ground between Gründoorn and Wasserfall, 8065. Among stones in river bed, Krai Kluft Ravine, 8261. River bed at outspan between Krai Kluft and Narudas Süd, 8088.

Eriocephalus aspalathoides, DC. *Central and Eastern Karasberg.* On plateau between Narudas Nord and Krai Kluft, 7923. Shallow ravine on eastern slopes, Narudas Süd, 7924.

Asaemia axillaris, Harv. *Central and Eastern Karasberg.* Second outspan between Krai Kluft and Narudas Süd, 8092.

Pentzia globosa, Less. *Western Karasberg.* Sandy bank of dry water course on high plateau 5 miles south-east of Wasserfall, 7926.

Pentzia globosa, Less., var. glandulosa, L. Bolus, nov. var., puberula, haud canescens, glandulosa, foliorum segmentis angustissimis, saepius mucronulatis. *Western Karasberg.* Sand dunes between Noachabeb and Gründoorn, 7941.

Pentzia virgata, Less. *Central and Eastern Karasberg.* Sandy plains, Krai Kluft and Narudas Süd, 7925.

Pentzia quinquefida, Less., var. nana *Western Karasberg.* Dry stream slopes (quartz) 200 ft. above Wasserfall Alt Ravine, 7927.

Cineraria albicans, N. E. Br., probably, but flowers immature. *Central Karasberg.* In rock crevices, summit of Scharfenstein, 7922.

Senecio niveus, Less. *Western Karasberg.* In partial shade on sandy banks of Dassiefontein River, 7921.

Senecio Diodon, DC. Exact locality uncertain, 7940.

Euryops multifidus, DC. *Eastern and Central Karasberg.* Common on upper eastern slopes of first ridge, Narudas Süd and Krai Kluft, 8186.

Othonna retrofracta, Jacq. *Central Karasberg.* Sandstone plateau on summit of long hill east of Krai Kluft, 7920.

Othonna cylindrica, DC. *Central and Eastern Karasberg.* Krai Kluft, 7918. Sandy plains, Narudas Süd, 7919.

Othonna sp. (deflorate). *Central Karasberg.* Summit of Scharfenstein, 7757.

Garuleum Schinzii, Hoffm. *Eastern and Central Karasberg.* Camel paths between Narudas Süd and Krai Kluft and at Narudas Süd, 7935.

Tripteris sinuata, DC. *Central Karasberg.* Stony plains, south-west of Krai Kluft, 7936.

Tripteris microcarpa, Harv. *Eastern Karasberg.* Sandstone, Narudas Süd, 8226.

Osteospermum muricatum, E. Mey. *Central and Eastern Karasberg.* Second outspan between Krai Kluft and Narudas Süd, river bed, 8100.

Gorteria corymbosa, DC. *Western Karasberg.* Dry banks of riverine gravels in Dassiefontein river bed, 7938.

Gazania Lichtensteinii, Less. *Western Karasberg.* On quartz strewn slopes and in hard dry sand on granite plateau between Dassiefontein and Noachabeb, 7937.

Berkheya Schenckii, O. Hoffm. *Eastern Karasberg.* Near old camp, Narudas Süd, 8331.

Berkheya annectens, Harv. Exact locality uncertain, 7939.

Dicoma capensis, Less. *Western Karasberg.* Stony slopes on granite plateau between Dassiefontein and Noachabeb, 7916.

### CAMPANULACEAE

Lightfootia tenella, A. DC. *Central Karasberg.* Summit of Scharfenstein, 8552.

### PLUMBAGINEAE

Vogelia africana, Lam. *Central Karasberg.* Lower slopes of Scharfenstein, 8548.

### EBENACEAE

Royena pallens, Thunb. *Central and Eastern Karasberg.* Near water at head of ravine, Krai Kluft, 8206; sandy river bed north-east of Narudas Süd, 8151.

Euclea lancea, Thunb. *Western and Central Karasberg.* High plateau between Wasserfall and Krai Kluft, 8250.

Euclea lanceolata, E. Mey. *Eastern Karasberg.* Ravine below Narudas Süd, 8549.

### ASCLEPIADACEAE

Cryptolepis decidua, N. E. Br. *Western and Eastern Karasberg.* Steep loose shale slopes, Wasserfall Alt Ravine, 8464. Summit of dolerite foothill, Narudas Süd, 8325.

Raphionacme sp. (in fruit). Exact locality uncertain, 8472.

Microloma Massonii, Schltr. *Central Karasberg.* Summit of Scharfenstein, in rock crevices, 8462.

Microloma incanum, Decne. *Central and Eastern Karasberg.* Lower slopes, Krai Kluft, 8113. Stony slopes, Naruda Süd, 8132.

Asclepias Burchellii, Schltr. *Western and Central Karasberg.* Granite knoll on plateau between Dassiefontein and Noachabeb, 8458. Krai Kluft in river bed, 8191.

Pentarrhinum insipidum, E. Mey. *Central Karasberg.* Among bushes and stones at head of Krai Kluft Ravine, 8201.

Cynanchum orangeanum, N. E. Br. *Western and Eastern Karasberg.* Plains between Dassiefontein and Noachabeb, 8459.

Sarcostemma Pearsonii, N. E. Br. *Central and Eastern Karasberg.* Stony plains south-west of Krai Kluft, 8460. Narudas Süd, 8461.

Tylophora Fleckii, N. E. Br. *Central Karasberg.* Krai Kluft, 8207.

Pergularia gariepensis, N. E. Br. *Western and Central Karasberg.* In sand in Wasserfall Alt Ravine, 8465. River bed, Krai Kluft, 8291.

Trichocaulon meloforme, Marl. *Central Karasberg.* Among stones, Krai Kluft, 8470.

Hoodia Gordoni, Sweet. *Eastern Karasberg.* Among bushes on sandy plains east of Narudas Süd, 8242.

Stapelia flavopurpurea, Marl. Exact locality uncertain, 8469.

Stapelia albocastanea, Marl. *Eastern Karasberg.* Under bushes, on sandy slopes, 8471.

Stapelia Pearsonii, N. E. Br. *Eastern and Central Karasberg.* Narudas Süd, and rocks above the camel path between Narudas Süd and Krai Kluft, 8539.

### HYDROPHYLLACEAE

Codon Royeni, L. *Central Karasberg.* River bed, Krai Kluft Ravine, 8285.

### BORAGINEAE

Tournefortia tuberculosa, Cham. *Central and Eastern Karasberg.* Second outspan between Krai Kluft and Narudas Süd, river bed, 8091. Banks of the Keiap River below Narudas Süd, 8240.

Ehretia Hottentotica, Burch. *Central Karasberg.* Near water, Krai Kluft Ravine, 8260.

Heliotropium strigosum, Willd. *Western Karasberg.* Steep slopes above Wasserfall Alt Ravine, 8550.

Trichodesma africanum, R. Br. *Central Karasberg.* Among rocks at bottom of Krai Kluft Ravine, 8551.

Wellstedia Dinteri, Pilger. *Western and Central Karasberg.* Sandy places on high plateau between Krai Kluft and Wasserfall, 8576.

### CONVOLVULACEAE

Ipomaea fragilis, Choisy. *Central and Western Karasberg.* Bank of dry stream-bed on high plateau between Krai Kluft and Wasserfall, 7959.

Ipomaea adenioides, Schinz. *Western, Central and Eastern Karasberg.* Rocky places near water, Wasserfall Alt, 8245. Common on lower slopes, Krai Kluft, 8111. Common on sandy plains and on hills, Narudas Süd, 8265.

Convolvulus ulosepalus, Hall. f. *Central Karasberg.* Trailing over sand and stones in river bed, Krai Kluft, 7960.

# NOVITATES AFRICANAE

1. Erica Muirii, L. Bolus (*Euerica*, § *Leptodendron*). Aliquibus formis *E. campanulatae* proxime sed sepalis crassioribus, corolla longiore straminea, antheris subexsertis aristatis, stylo valde exserto, stigmate capitato, differt.

Fruticulus subrigidus, circ. 30 cm. altus; folia erecta 3nata, breviter petiolata, imbricata vel rarissime internodios aequantia, linearia obtusa, angustissime sulcata, glabra, 0·2–0·3 cm. longa; flores 3nati, patentes vel erecti, pedicellis pubescentibus, 0·5 cm. longis; bracteolae duae approximatae adpressae, tertia subapproximata, ovatae vel ovato-lanceolatae, scariosae foliaceo-apiculatae, 0·2 cm. longae; sepala bracteolis simillima, 0·3 cm. longa; corolla tubularis, subobliqua, basin versus subattenuata, fauce parum constricta, glabra straminea, 0·9 cm. longa, segmentis erecto-recurvatis rotundatis, margine crenulatis, 0·15 cm. longis; antherae subexsertae vel rarissime exsertae, parum supra basin dorsifixae, oblique oblongo-lanceolatae, subacutae brunneae, 0·2 cm. longae, poro dimidio cellae, aristatae, aristis patentibus, 0·05 cm. longis; ovarium 4loculare subobconicum glabrum, 0·2 cm. longum, stylo exserto, stigmate capitato.

Cape Colony: South-Western Region; Mossel Bay Div., Cloete's Pass, fl. Sept. 1913, Dr Jno. Muir, 1061.

A rather rigid subshrub, about 30 cm. high; leaves erect 3nate, shortly petiolate, imbricate or very rarely as long as the internodes, linear obtuse, very narrowly sulcate, glabrous, 0·2–0·3 cm. long; flowers 3nate, spreading or erect, the pedicels pubescent, 0·5 cm. long; two of the bracteoles approximate appressed, the third subapproximate, ovate or ovate-lanceolate, scariose, foliaceous at the apex, 0·2 cm. long; sepals like the bracteoles, 0·3 cm. long; corolla tubular, somewhat oblique, slightly narrowed towards the base, a little constricted at the throat, glabrous straw-coloured, 0·9 cm. long, the segments erect-recurved, crenulate on the margin, 0·15 cm. long; anthers subexserted or very rarely exserted, dorsifixed a little above the base, obliquely oblong-lanceolate, subacute brown, 0·2 cm. long, the pore half as long as the cell, aristate, the awns spreading, 0·05 cm. long; ovary 4-celled, somewhat obconic, glabrous, 0·2 cm. long, style exserted, stigma capitate.

Allied to some of the forms of *E. campanulata*, but differs in having thicker sepals, longer straw-coloured corolla, subexserted aristate anthers, style well exserted and capitate stigma.

2. ERICA HAMERIANA, L. Bolus (*Euerica*, § *Orophanes*). *E. sitienti* affinis sed pedicellis multo longioribus, floribus majoribus, antheris aristatis differt.

Suffruticosa, ramis pubescentibus, demum glabris, ad 40 cm. longis; folia adscendentia vel erecta, saepissime imbricata, 4nata, breviter petiolata, linearia subacuta, angustissime sulcata, glabra, 0·4–0·7 cm. longa, vix 0·1 cm. lata; flores 4nati, vel saepe 3–1nati, patentes vel adscendentes, cremesini, pedicellis glabris, ad 0·8 cm. longis; bracteolae 3, infima pedicelli medio vel infra, aliae supra medium positae, lineari-lanceolatae, scariosae, 0·15–0·2 cm. longae, sepala subulata, longe attenuata, glabra, margine scariosa, inconspicue ciliata, 0·5 cm. longa; corolla obliqua tubularis, basi attenuata, fauce leviter constricta, 1·2 cm. longa, segmentis rotundatis, albis vel tubo pallidioribus, 0·15 cm. longis; antherae inclusae, parum supra basin dorsifixae, late ovatae, hispidulae, atro-purpureae, 0·07 cm. longae, poro vix dimidio cellae, aristatae, aristis ciliatis, cella longioribus; ovarium 4loculare obconicum glabrum, 0·2 cm. longum, stigmate exserto capitellato.

CAPE COLONY: South-Western Region; Caledon Division, probably near Sir Lowry's Pass; bought from the flower-sellers in Cape Town, Feb., N. S. Pillans, 1079.

Suffruticose, the branches pubescent, finally glabrous, up to 40 cm. long; leaves ascending or erect, usually imbricate, 4nate, shortly petiolate, linear subacute, very narrowly sulcate, glabrous, 0·4–0·7 cm. long, scarcely 0·1 cm. broad; flowers 4nate, or often 3–1nate, spreading or ascending, crimson, the pedicels glabrous, up to 0·8 cm. long; bracteoles 3, the lowest medial or below the middle of the pedicel, the others above the middle, linear-lanceolate, scariose, 0·15–0·2 cm. long; sepals subulate, attenuate, glabrous, the margin scariose, inconspicuously ciliate, 0·5 cm. long; corolla oblique tubular, narrowed at the base, slightly constricted at the throat, 1·2 cm. long, the segments rounded, white or paler than the tube, 0·15 cm. long; anthers included, dorsifixed a little above the base, broadly ovate, hispidulous, dark purple, 0·07 cm. long, the pore less than half the length of the cell, aristate, the awns ciliate, longer than the cell; ovary 4-celled obconic glabrous, 0·2 cm. long, stigma exserted capitellate.

Allied to *E. sitiens* but differs in having much longer pedicels, larger flowers, and aristate anthers.

Named in honour of Mr A. Handel Hamer, an ardent worker in the cause of the protection of wild flowers.

# NATIONAL BOTANIC GARDENS

## KIRSTENBOSCH

By DOROTHEA FAIRBRIDGE

On the south-eastern slopes of Table Mountain lies the old estate known as Kirstenbosch. It was an outpost of the Dutch East India Company from 1652 to 1811, and its native forests were doubtless amongst those which furnished supplies of building timber to the early settlers. Dowered with rich soil, perennial streams and shelter from raging winds, the trees must have attained considerable girth. Here probably lived the forest ranger, in whose charge were the yellow-woods and other trees of the district.

Students of Cape history will remember that in 1658 Jan van Riebeek raised his voice in protest against the wanton destruction of the yellow-wood trees in the forests of the Cape Peninsula. He was in a position to do more than protest, for he issued an edict which might have saved many fine trees had succeeding generations been as wise as the little Commander. He himself was the owner of the neighbouring estate of Boscheuval, now Bishopscourt, which he planted with vines and fruit trees and fenced round with a hedge of bitter wild almonds—Brabeium stellatifolium. This hedge may still be traced, crossing the hill from Kirstenbosch to Wynberg.

Not far off was the fort of Hout den Bul, established by van Riebeek as a safeguard against a horde of Hottentots living near Hout Bay. He describes Boscheuval as lying "within the area marked off by the Company as its possessions, within sight of the watch-house Hout den Bul, and sufficiently protected."

The naming of Kirstenbosch is sometimes attributed to Johan Frederik Kirsten, or to his son. The former, who died in 1783, was Junior Merchant and Ledger Keeper in the Company's service, the latter was Private Secretary to the Governor in 1786, but there is nothing to connect either of them with the place except the not particularly relevant fact that in 1793 a Johanna Jacoba Kirsten married a Hendrik Cloete whose nephew subsequently owned the property. In the early documents the name appears as Kersianbosch—the cherry-bush. I know of no shrub growing here which would justify the use of the word "cherry," though van Riebeek has recorded that he planted eleven cherry trees on the neighbouring land of Boschendal. Possibly one of these trees may have yielded descendants which throve for a while in the rich land near the mountain—but this is pure hypothesis.

It is not until 1811 that we come to any very concrete facts regarding Kirstenbosch. In that year the following grant was made by the Governor—Lord Caledon—to Colonel Christopher Bird.

"A piece of land in the Cape district, beyond the Government place, Kirstenbosch and the properties of H. D. Maynier [Boscheuval] and W. Versveld [Klassenbosch], at the foot of the Table Mountain, in extent 107 morgen, 1 square rood and 72 square feet, with the right of the fountain springing on the said piece of land, stretching east and southward to the places of Maynier and Versveld, to the north to the limits of the Government ground."

Later on, in the same year, the adjacent ground was granted to Henry Alexander, then Colonial Secretary, an eccentric Irishman who built himself a house on the site of the ranger's dwelling—the ruins of the homestead nearest to the entrance mark the spot. There were no windows to his bedrooms, for, as he explained, people went to bed to sleep—not to look at the view.

The grant was made—

"On a letter of recommendation from H.M. Secretary of State, by letter dated 22nd of February 1811, and consisted of a piece of land 197 morgen, 450 square roods, extending north-east to the Government land and towards the place of Mr Alexander van Breda [Boshof], eastwards to the Government land, south towards the Liesbeek River, and south-east to the place of Mr Bird."

A diagonal line drawn from below the old fountain and above the ruins of the large homestead would give an idea of the division of the land. It is interesting to note that in the survey of the property made at this time by Louis Thibault a dwelling-house and out-buildings are shewn on the site of the present ruins, proving that Mr Alexander's house was not the first Kirstenbosch. The beautiful little sunk bath is marked on Colonel Bird's portion as the "fontein," but in the grant there is no sign of a house on his property. Probably he built the small house, now in ruins, a little distance behind the large homestead. There are old Spanish chestnuts near it, and it is known that he planted chestnuts on the slopes of the mountain.

Henry Alexander died at the Cape, Colonel Bird left the country, and the whole estate of Kirstenbosch appears to have reverted to the Government in 1817. Shortly afterwards it was bought by Mr Dirk Eksteen, a member of one of the oldest Cape families, who rebuilt the main house, which had by this time become a ruin. He found it necessary to cut down trees which had grown up in the rooms—a testimony, if testimony were needed, to the fertility of the Kirstenbosch soil. Mr Eksteen's was the third house built on the site of the old ranger's cottage, in the shade of the great oaks which may well have been amongst the earliest trees planted by the Dutch East India Company.

His daughter married Mr Hendrik Cloete, who succeeded him in the ownership of the fine estate. It was from the Cloete family that the site of the National Botanic Gardens of the Union of South Africa was purchased by Cecil John Rhodes. As part of the great estate of Groote Schuur it passed, on his death, to the people of South Africa.

**Lord de Villiers.** The death of Lord de Villiers is a grievous loss to South Africa. Of the many public activities of the late Acting Governor-General and Chief Justice of the Union, whose devotion to the welfare of South Africa was a national asset of the highest worth, this is not the place to speak. To the National Botanic Gardens he was a tower of strength, whose removal at this early period of their history cannot be too deeply deplored.

Lord de Villiers, who has done so much for the conservation of the flora and of objects of historic interest in the Union, took a leading part in the establishment of the National Botanic Gardens in 1913. He was one of the three Trustees appointed by the Government and became in due course the first Chairman of the Board of Trustees. From the first until a few days before his death he continually gave proof of his deep interest in their welfare and development. He visited Kirstenbosch with great frequency and maintained an intimate knowledge of the work in progress and in contemplation. He was always ready to exercise his wide influence in the affairs of the Gardens, and those immediately responsible for their administration never sought his sage advice in vain. The National Botanic Gardens will for all time be associated with the name of the first Baron de Villiers, to whose memory they will constitute a monument such as he himself would have approved.

# REVIEW

THE FLORA OF SOUTH AFRICA, WITH SYNOPTICAL TABLES OF THE GENERA OF THE HIGHER PLANTS. By Rudolph Marloth. Vol. I. Large 8vo. pp. xviii, 264, with 36 coloured and 30 monochrome plates and 109 text-photographs and figures. *Cape Town: Darter Bros. & Co. London: William Wesley & Son.* 1913.

All who are interested in the wonderful vegetation of South Africa will welcome the appearance of the first volume of this work. It is to be followed by three others of the same type and a supplementary volume which is to contain, among other valuable matter, a map with explanatory notes on the phytogeographical regions of South Africa and an index of English and Dutch names of South African plants. When it is completed, it will be one of the most notable contributions yet made to the advancement of South African Botany. Nothing of quite the same kind has hitherto been attempted either in South Africa or elsewhere. The sumptuous character of the work, which will be highly appreciated by all who realise the remarkable wealth and beauty of the material which offers itself for treatment, has been made possible by the generosity of Lady Phillips who thus renders a very signal service to the study of Botany in South Africa; its execution could only have been entrusted to one who possesses a wide knowledge of the living vegetation of South Africa and therefore to none so appropriately as to Dr Marloth.

The volume before us devotes 38 pages to the Thallophyta; 21 to the Bryophyta; 23 to the Pteridophyta; 22 to the Gymnosperms and 126 to the lower groups of the Dicotyledons up to and including the Rhoeadales. In a work bearing the title *The Flora of South Africa* and which confessedly gives to the term "Flora" a broad and scientific connotation, one might expect that when the seed-bearing plants are treated with so lavish a generosity, the setting forth of the lower groups would have been somewhat less curtailed. But although Dr Marloth has had the assistance of various botanists possessing special knowledge of some of the more primitive groups—which is suitably acknowledged in the preface and elsewhere—one must remember that comparatively little attention has yet been given in South Africa to groups lower than the seed-plants. And there is no doubt that the few pages devoted to some of these will serve a useful purpose. For example, the keys to the genera of the Bryophyta known to occur in South Africa cannot fail, at the same time, to emphasise the need for further investigation, and to assist those who are prepared to undertake it. The rather remarkable omission of Riella, a locally common and extremely curious form, from Dr Diels' synopsis of the genera of liverworts, may be noted incidentally. In some other cases, e.g. that of the Chlorophyceae (pp. 8–10), one wonders whether the few details which it has been possible to crowd into so small a space are sufficient to justify their inclusion in a work of this character.

The account of the lower seed-bearing plants includes some of the most interesting and best known of the forms represented in the extremely varied vegetation of South Africa—the Proteaceae, Mesembrianthema, the Cycads, Welwitschia and a number of curious parasitic dicotyledons. Other families of outstanding interest remain for the later volumes but it may safely be said that none of them is likely to contain a larger proportion of plants of general interest than are to be found here.

Those who are familiar with the illustrations employed by the author in his earlier writings will open this work with pleasant anticipations which will most certainly be realised. We have heard it said that the volume is expensive. But those who can appreciate such things will admit at once that the reproductions of the photographs alone are worth every penny of the cost of the whole work. Many of them are from Dr Marloth's own camera; some from those of other well-known plant-photographers. But they all attain to so high a standard of excellence that it is really hardly fair to particularise any. Apart from their excellence as photographs they all possess the great merit of shewing the plant in its natural surroundings, and so furnish oecological studies of the most valuable character. The coloured plates form an important part of the work and will appeal strongly to very many who have hitherto sought in vain for a ready means of identifying common or conspicuous species. Naturally it has been possible to represent but a small proportion of the species in this way, but enough has been done, and in such a way as to serve this purpose admirably. Considering the enormously wide area from which the material for these plates has been drawn, the attainment of results of such general excellence is really remarkable and reflects great credit on the artists employed. In some cases, it is true, the artist has apparently attempted to produce rather than to reproduce. The colour of the leaves of *Encephalartos Altensteinii* (Plate 15) is a little unfamiliar; those of the cones of Welwitschia (Plate 21), particularly that of the male cones, are unnatural. The drawing is not always accurate—for example Fig. 8 on Plate 21 gives to the bract an elongated apex which is really the projecting part of the tubular micropyle, as is clearly shewn in Fitch's figure published by Hooker in 1863. But these and other like blemishes may well be minimised in so great a series of representations for the preparation of which it must have been extremely difficult to obtain adequate material. Nevertheless, so great and so successful were the pains taken to secure specimens that it has been impossible to represent them adequately without occasionally unduly overcrowding the plates—a sacrifice of their artistic arrangement to a desire to increase their practical value to those who will use them.

The plates and figures are accompanied by descriptive matter containing much valuable information regarding the living plants which few know so well as the author. Some of it is now printed for the first time; most of it is for the first time placed within easy reach of the general reader. It includes the results of an extensive series of close personal observations of the plants growing under natural conditions and it is therefore in complete harmony with the growing tendency to study the plant as a living thing subject to the action of natural laws rather than merely as an object confined in a bottle or fastened down to a herbarium sheet. And the great value of these descriptions, aided as they are by the plates, figures and drawings of various kinds, is largely due to the stress laid upon the relations existing between the plant and its environment—soil, water, light, animals, etc. Some of the theories adopted will no doubt be modified as our knowledge of these things increases, but the way in which these questions are dealt with is usually admirable. A few inaccuracies in such a mass of descriptive matter are inevitable. For example, the Welwitschia cones figured on p. 107 and described as "ready for pollination" were, without doubt, not only pollinated but also fertilised some weeks before they reached the stage represented. And this mistake will account for the erroneous statement on another page that "there is scarcely any increase in the size of the cone after fertilisation, nor much change in the colour of the scales." Slips of this character may be forgiven perhaps more easily than the author's attempt (we trust abortive) to discredit the well-established name *Welwitschia mirabilis* and to substitute for it *W. Bainesii*[1] the authority for which is very questionable.

The most vulnerable part of this work is to be found in the introductory theoretical chapters. The work is designed to be a "guide to the student" and these chapters will presumably be read by those in search of the fundamental principles of the science.

It is therefore unfortunate that the macrospore of the gymnosperm is called the "female organ" and doubly so that both the microspore and the pollen grain are described as "male organs." The statement that in the Gymnosperms "both generations, the sexual and asexual, are condensed into one, the nucellar tissue only being the equivalent of the prothallium of the ferns" (p. 90) is a morphological heresy. Similarly with regard to the Angiosperms the only meaning which seems to be conveyed by the words "The alternation of...generations...is here quite obliterated, the sexual organs being produced by the sporophyte" gives quite a false idea of the somewhat curtailed series of events which constitute the characteristic life-history in this group. And the description of a Cycad or a Pine as "by analogy a sporophyte but by function a gametophyte" is a hard saying. Other equally misleading statements might be quoted, indicating that the author was unable to give to these portions of his book the care and judgment which has so evidently gone to the making of the rest of it.

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[1] This specific name was first used by Hooker, not by Welwitsch as stated on p. 111.

But when all needful criticism has been made, Dr Marloth's work remains one for which all who desire the extension of the interest in and knowledge of the South African Flora will be grateful. Many of those who read it will hardly appreciate the great labour and sacrifice of which it is the fruit. We trust that both Lady Phillips and Dr Marloth will have the reward which alone can recompense them for the time, labour and money which have been expended on this work—viz. that measure of public appreciation which it so richly deserves.

It only remains to say that the book itself is in every way worthy of the subject with which it deals and of the matter which it contains. The letterpress was printed at the Cambridge University Press.

H. H. W. P.

# EXPLANATION OF PLATES

## PLATE VII

*as*=air-space; *vr*=vascular ring; *p*=pith; *c*=cortex; *wc*=water-cell; $gt^2$=secondary ground-tissue.

### EUPHORBIA VIROSA.

Fig. 1. Trans. sect. vascular cylinder near stem-apex × 5; 2, trans. sect. mature stem × 1; 3, trans. sect. of air-cavity in Fig. 1 × 150; 4 and 5, long. sect. vascular cylinder of mature stem × 1.

### ALOE DICHOTOMA.

Fig. 6. Trans. sect. young primary ground-tissue of stem × 150; 7, trans. sect. older primary ground-tissue of stem × 70; 8, trans. sect. young secondary ground-tissue of stem × 100.

## PLATE VIII

A. 1, portion of plant × 1; 2, capitulum × 2; 3, disc floret with stigmas emerging × 4; 4, two anthers × 5; 5, achene; 6, style and stigma × 8.

B. 1, portion of plant × 1; 2, flower with pedicel and bracts × 4; 3, part of corolla × 4; 4, one petal flattened to shew outline × 4; 5, column and coronal scales × 30; 6, outer view of two coronal scales × 40; 7, inner view of two coronal scales × 40; 8, staminal column × 30; 9, apex of style × 30; 10, one stamen (seen from inside) shewing position of pollinia × 50; 11, pollinia × 50.

C. 1, portion of plant × 1; 2, corolla opened out × 1; 3, outer coronal lobe (a simple scale); 4, inner coronal lobe (a two-horned scale); 5, pollinia × 10.

## PLATE IX

A. 1, sketch of a branch, nat. size; 2, flower; 3, pedicel with bracteoles; 4, sepal; 5, corolla—all the latter × 3; 6, stamen, side view; 7, ditto, back view— × 5; 8, gynaeceum × 4; 9, leaf, back view × 6.

B. 1, sketch of a branchlet, nat. size; 2, flower × 2; 3, pedicel and bracteoles × 3; 4, sepal × 4; 5, corolla × 2; 6, anther, side view × 10; 7, ditto, back view; 8, gynaeceum × 5; 9, leaf × 4.

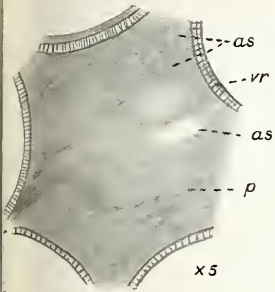


Fig. 1

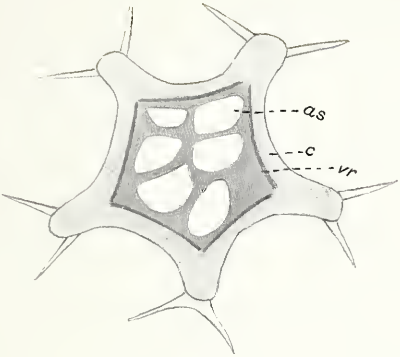


Fig. 2

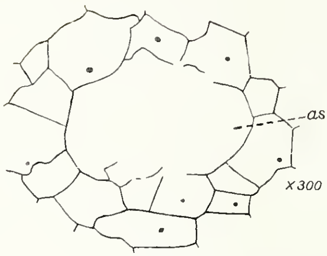


Fig. 3

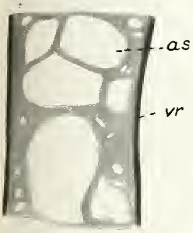


Fig. 4

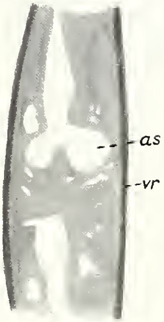


Fig. 5

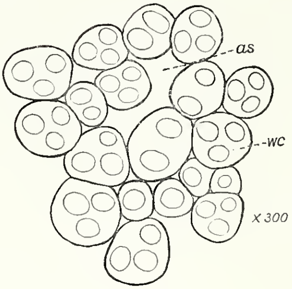


Fig. 6

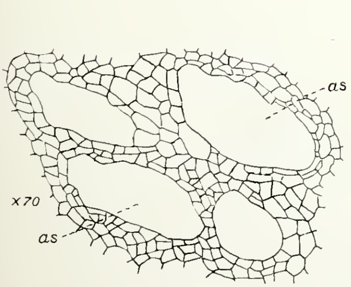


Fig. 7

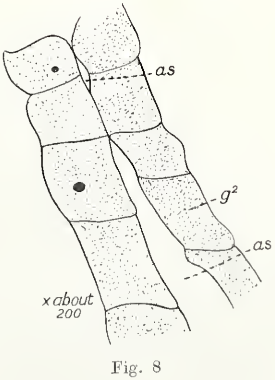
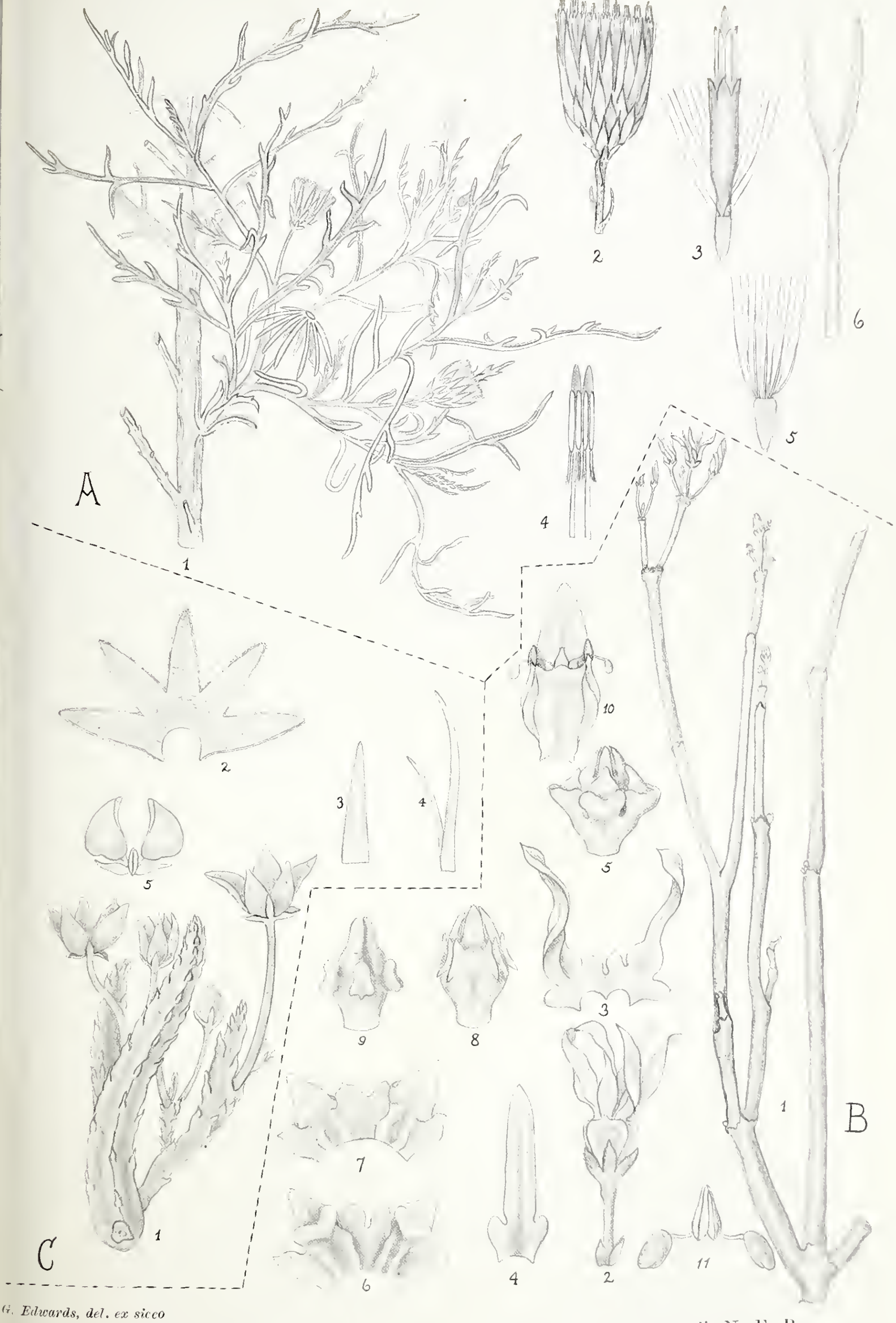
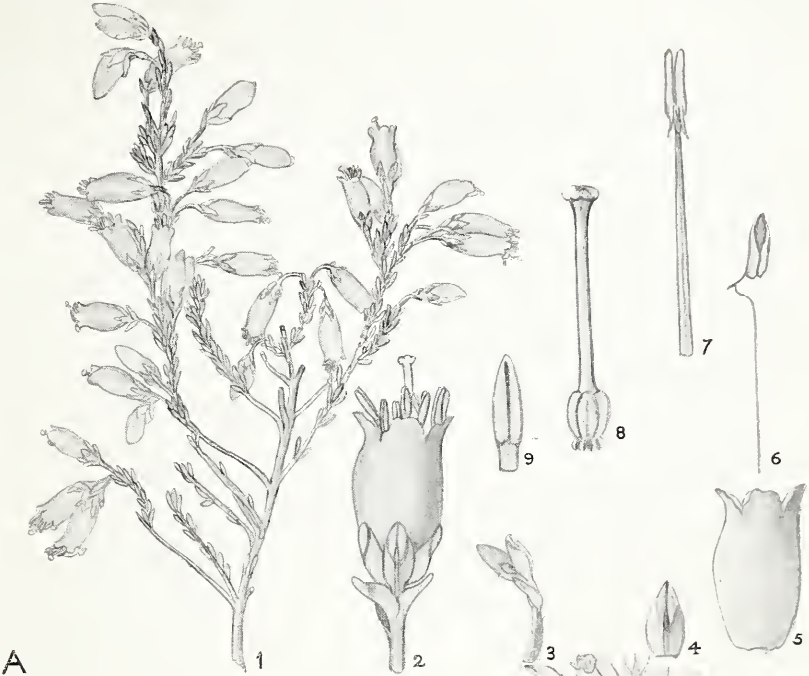


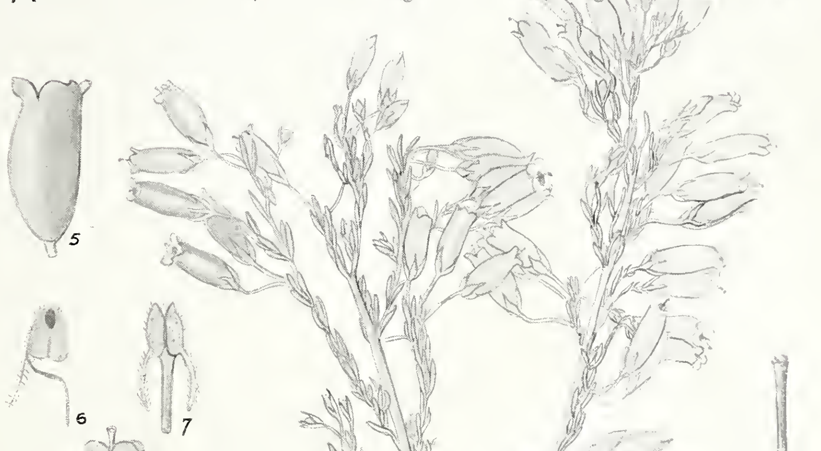
Fig. 8



*G. Edwards, del. ex sicco*

A. Iphiona pinnatisecta, S. Moore. B. Sarcostemma Pearsonii, N. E. Br.
C. Stapelia Pearsonii, N. E. Br.





*M. W. Glover, del. ex sicco*

A. Erica Muirii, L. Bolus.

B. Erica Hameriana, L. Bolus.

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# NOTES ON LESSERTIA WITH DESCRIPTIONS OF SIX NEW SPECIES AND A KEY

BY L. BOLUS

THE genus *Lessertia*[1] comprises about 41 species and is confined to the southern portion of Africa. Only 5 species extend north of the Tropic—viz. *L. benguelensis*, Baker, in Angola (also found much further south in the Gt. Karasberg), *L. emarginata*, Schinz., in Amboland, *L. incana*, id., in Gt. Namaqualand (Aus.), *L. stipulata*, Baker, f., in Rhodesia (Salisbury) and *L. pauciflora*, Harv. var. in the Northern Transvaal. Of the others, approximately 11 species have been recorded from the Western Region[2], 14 from the South-western, 13 from the South-eastern, 5 each from the Karoo, Upper and Kalahari Regions, and 3 from the Eastern Mountain Province Region.

Its nearest African ally is *Sutherlandia* which differs in having much larger flowers with the carina considerably longer than the other petals and the alae comparatively small. From some species of *Swainsona* (chiefly Australian), however, where the pod is not longitudinally 2-locular by the intrusion of the ventral suture, it does not appear to differ at all and in my opinion these species must inevitably be reduced to *Lessertia* by some future worker who is able to examine both genera.

Nine plates of *Lessertia* are known—viz. Jacq., Ic. Rar., t. 576 (*L. diffusa*) and Hort. Schönbr., t. 222[3] (*L. annularis*), DC., Mém. Leg., t. 46 (*falciformis*), Delessert, Ic. Select., III, t. 69 (*macrostachya*) and t. 70 (*brachystachya*), Hook, Ex. Pl., t. 84 (*? linearis*), Bot. Mag., t. 2064 (*pulchra*) and t. 6106 (*perennans*) and Bot. Reg., t. 970 (*fruticosa*).

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[1] Established in 1802 and named in honour of Benjamin Delessert, a Frenchman who edited the *Icones Selectae* (1820–1846), a work in 5 vols. containing 500 beautiful outline drawings of plants.

[2] The Regions used here are those given by H. Bolus, "Sketch of Floral Regions of S. Africa," in *Science in S. Africa* (1905).

[3] Regarded in the Kew Index as *L. falciformis* but it appears to be rather *L. annularis* of which it has the characteristic ventral bearding of the style.

Lessertia varies in HABIT from diffuse or trailing slender perennial, very rarely annual, herbs to erect and sometimes rigid shrubs, 2—3 ft. in height.

The INDUMENT may be distinguished as being composed either of soft more or less spreading or crisp hairs or of rather rigid white, closely appressed strigose or hispid hairs. The former are often very copious, and frequently, on pedicel and calyx, almost black. I have not observed an entirely glabrous specimen in the genus. The petals and stamens, however, are always glabrous, while the ovary and upper leaf-surface are frequently so.

The STIPULES are almost uniform in shape throughout the genus, being obliquely ovate or lanceolate and foliaceous, usually under 0·6 cm. long. LEAVES shortly petiolate, imparipinnate, the leaflets 2—14-jugate (usually 5—7), often alternate, linear, oblong, or oblong-oval, more rarely obovate or suborbicular, obtuse or emarginate, rarely acute or acuminate, under 1 in. long. RACEMES axillary pedunculate, usually many-fld., dense or rather lax (in *macrostachya* very lax). BRACTS small and usually somewhat membranous, very rarely (*Kensitii*) large and foliaceous. CALYX SEGMENTS equal or subequal, very rarely longer than the tube. PETALS purplish blue, purple, crimson or rarely yellowish, usually about 6 ls. or less long (nearly 9 ls. in *Pappeana*), the VEXILLUM slightly longer than the rest. CARINA obtuse, as long as the ALAE or rarely (*spinescens*, *globosa* and *Flanaganii*) distinctly shorter. STAMENS diadelphous, the ANTHERS uniform. OVARY shortly stipitate several-ovuled, twice or more than twice as long as broad; STYLE bearded at the apex, either all round the stigma or, very rarely, dorsally only, or ventrally half-way down the style; STIGMA terminal, inconspicuous. LEGUME frequently membranous and transparent, or opaque and with the texture of parchment, glabrous or pubescent, varying in numerous gradations from suborbicular to linear, usually conspicuously oblique, the ventral suture being straight or nearly so, and the dorsal having a more or less wide sweep (the legumes resulting from the shorter ovaries are therefore considerably widened in the process, while those from the longer ovaries become falcate, annular or even spirally twisted), tardily dehiscing at the apex (not observed by me). SEEDS reniform, funiculus filiform.

L. spinescens, E. Mey., var. gracilior, nov. var., ramis tenuioribus; pedunculis elongatis.

Cape Province: South-western Region; Els Kloof, Hex River, fl. Aug., *A. H. Wolley Dod*, 4031; Cederbergen, nr. Clanwilliam, alt. 1600 ft., fl. Oct., *H. Bolus*, 8988; slopes of the Olifant Rivierbergen, alt. 300 ft., fl. Aug., *R. Schlechter*, 5079.

L. rigida, E. Mey., non DC. (*L. fruticosa, Lindl.? ex Harv., Flor. Cap.* II. 215).

Cape Province: South-western Region; sandy places, Rapenburg, nr. Cape Town, *F. Guthrie* (Bolus Herbarium, No. 7076). Kuil's River, *Pappe*; in sand, Hoetje's Bay, Saldanha Bay, alt. 50 ft., fl. Sept., *H. Bolus*, 12673; hill, nr. Hoetje's Bay, alt. 250 ft., fl. Sept., *id.*, 12672. Plate XII, A.

Harvey seems to have been uncertain as to the validity of this species, and was inclined to regard it as being *L. fruticosa*, Lindl. More recent collections have shown that the two species are quite distinct.

L. fruticosa, Lindl.

Western Region: Little Namaqualand; slopes between Nababeep and Modderfontein, alt. 3200 ft., fl. Sept., *H. Bolus*, 9496; nr. Klipfontein, alt. 3000 ft., fl. Aug., *id.*, 9497; nr. Ookiep, fl. Sept., *id.*, 9499, 9500.

L. perennans, DC., var. sericea, nov. var., ovario sericeo; legumine pubescente.

Cape Province: South-eastern Region; N'Zebanya Mt., nr. Queenstown, alt. 5100 ft., fl. Dec., *E. E. Galpin*, 1912. Kwenkwe Mt., Maclear, alt. 5300 ft., fl. Jan., *H. Bolus*, 13235. Kaffraria, Slang River (Ekowe), Gatberg, alt. 400 ft., fl. Dec., *R. Baur*, 1163. Orange Free State, *T. Cooper*, 1861. Eastern Mount. Prov. Region; Bester's Vallei, Harrismith, alt. 5400—6500 ft., fl. Dec., *H. Bolus*, 8153. Kalahari Region; Transvaal, Germiston, alt. 6000 ft., fl. Jan., *F. A. Rogers*, 12199 c. (Harv.) L Bolus

L. perennans, DC., var. polystachya. *L. polystachya, Harv., Flor. Cap.* II. 216.

L. pauciflora, Harv., var. Schlechteri, L. Bolus. *L. Schlechteri, Bolus,* in *Engl. Bot. Jahrb.*, 24, 458.

This variety forms a connecting link between *L. pauciflora* and *L. falciformis*. I have seen no authenticated specimens of these two species except *Zeyher*, 471 (regarded by Harv. as a variety of the former), where the bearding of the style is round the stigma only. This latter character seems the best distinction between *L. falciformis* and *L. pauciflora* (where the style is bearded ventrally as well as apically). *Zeyher*, 471 should therefore be rather a variety of *L. falciformis*.

L. Harveyana, n. sp., *L. strictae* proxime accedit, sed foliolis floribusque paucioribus, pedicellis calyce brevioribus, leguminibus sublatioribus distinguitur.

Herba erecta vel decumbens, fere glabra, ramis suberectis vel patentibus, tenuibus strictis pallidis, ad 40 cm. longis, internodiis 1·5—5 cm. longis, saepissime 2 cm. longis; stipulae lanceolatae acuminatae, 0·3—0·4 cm. longae; folia adscendentia, deinde patentia

1·5—3·5 cm. longa, petiolo 0·2—0·5 cm. longo, foliolis 2—5-jugis, ellipticis vel obovato-oblongis, apiculatis, supra glabris, infra parce adpresso-pubescentibus, 0·6—1·3 cm. longis, 0·2—0·6 cm. latis, terminali lateralibus saepius majore; pedunculi foliis aequilongi vel duplo longiores, apicem versus laxe 2—3-flori, floribus cernuis; bracteae lineari-lanceolatae, pedicellis 0·3 cm. longis parum brevioribus; calyx parce adpresso-pubescens, 0·4—0·5 cm. longus, segmentis lanceolatis acuminatis, tubo paullo longioribus; vexillum 0·6 cm. longum, lamina subreniformi, vix retusa, ungue fere 0·2 cm. longo; alae vexillo paullo breviores, lamina oblonga obtusissima, anteriore basi obscure lobata, lobo posteriore brevi obtuso; carina vexillo aequilonga, ungue lamina duplo breviore; ovarium semi-ellipticum glabrum pluri-ovulatum, 0·4 cm. longum, stylo breviore, circum stigma barbato; legumen subinflatum, oblique ellipticum, in stylum persistentem induratum desinens, ad 2·5 cm. longum, 1·1 cm. latum. *L. biflora*, Harv. MSS.

Cape Province: South-eastern Region; Albany Div., damp places, Bothasberg, alt. 2200 ft., *MacOwan*, 488. Zuurbergen, alt. 4800 ft., fl. Feb., *R. Schlechter*, 6574. Pirie, nr. King William's Town, alt. 2000 ft., fl. Nov., *H. G. Flanagan*, 2143. Fort Cunynghame, fl. Nov., *T. R. Sim*, 2764. Transkei, Kentani, alt. 1000 ft., fl. Nov., *A. Pegler*, 1281. Between Nkwamakwe and Engcobo, alt. 3000 ft., fl. Jan., *Bolus*, 8880. Griqualand East, stony places at the foot of Mt. Currie alt. 5000 ft., fl. Feb., *W. Tyson*, 1803.

Very closely allied to *L. stricta*, Bolus, but may be distinguished by having fewer leaflets and flowers, pedicels shorter than the calyx and rather broader legumes. Plate X, A.

L. Flanaganii, n. sp., affinis *L. depressae* sed foliolis setaceo-acuminatis, pedunculis longioribus, carina alis multo breviore, differt.

Herba perennis nana, compacta vel subdiffusa, parcissime adpresso-puberula vel fere glabra, ad 10 cm. alta, caudice lignoso, ad 0·6 cm. diam.; rami adscendentes densi breves vel demum patentes subelongati, angulares, internodiis 0·8—1·3 cm. longis; stipulae lanceolatae vel oblique ovato-lanceolatae, setaceo-acuminatae, 0·5—0·6 cm. longae; folia adscendentia, 2—3 cm. longa, petiolis 0·4—0·8 cm. longis, foliolis 3—6-jugis, lanceolatis vel ovato-lanceolatis, setaceo-acuminatis, marginibus subinvolutis, 0·6—0·9 cm. longis; pedunculi saepius foliis duplo longiores vel ultra, rarius eis aequantes, apicem versus densius 3—5-flori; bracteae lanceolatae acuminatae, pedicellos 0·3—0·4 cm. longos aequantes vel excedentes; calyx parce adpresso-pubescens, 0·5 cm. longus, segmentis acuminatis ciliolatis, tubo aequantibus; vexillum late obovatum, ad 1 cm. longum, ungue perbrevi, 0·15 cm. longo; alae vexillo aequilongae, lamina oblonga obtusa, lobo posteriore brevi, 0·6 cm. longa; carina obtusa, 0·7 cm. longa; ovarium lineari-oblongum subobliquum multiovulatum glabrum, vix 0·4 cm. longum, stylo circum stigma barbato; legumen ignotum.

Cape Province: South-eastern Region; grassy hill nr. Komgha, alt. 2000 ft., fl. Sept., *H. G. Flanagan*, 791.

Allied to *L. depressa*, but differs in having the leaflets setaceo-acuminate, the peduncles longer, and the carina much shorter than the alae. Plate XII, B.

L. Dykei, n. sp., affinis *L. tomentosae,* sed stylo intus per longitudinis dimidium barbato, legumine oblique obovato-oblongo, differt.

Herba subdiffusa, cano-pubescens brevibus patentibus pilis; rami angulati, ad 15 cm. longi, internodiis 1—2 cm. longis; stipulae ovato-lanceolatae acuminatae, 0·2—0·3 cm. longae; folia adscendentia vel patentia, ad 5 cm. longa, petiolis 1—1·5 cm. longis, foliolis 3—9-jugis oblongis, apice integris vel excisis, supra glabris, 0·6—1·2 cm. longis, 0·2—0·4 cm. latis; pedunculi foliis aequilongi vel paullo breviores, apicem versus 4—7-flori, floribus adscendentibus; bracteae ovato-lanceolatae acuminatae, 0·2—0·3 cm. longae; pedicelli 0·3—0·4 cm. longi; calyx 0·5 cm. longus, segmentis lanceolatis attenuatis, tubo paullo longioribus; vexillum late obovatum, 0·9 cm. longum; alae 0·8 cm. longae, lamina oblonga obtusa, lobo posteriore patente oblongo obtuso, ungue 0·25 cm. longo; carina obtusa, alis aequilonga, ungue 0·3 cm. longo; ovarium anguste semi-ellipticum, dense sericeum, pluri-ovulatum, stipite 0·1 cm. longo excluso, 0·4 cm. longum, stylo intus per longitudinis dimidium barbato; legumen inflatum, oblique obovato-oblongum, pubescens, circa 2 cm. longum, 1 cm. latum.

Natal: Eastern Mountain Province Region; slopes of Mont-aux-Sources, alt. circa 8000 ft., fl. Dec., *H. G. Flanagan* (Bolus, No. 8152). *Ibid.*, fl. April, *E. Dyke* (Marloth, No. 5445).

Allied to *L. tomentosa*, DC., but differs in having the style bearded within for half its length, and the legume obliquely obovate-oblong. Plate XI, B.

L. globosa, n. sp., affinis *L. prostratae,* sed indumento adpresso, pedunculis foliis multo brevioribus, legumine majore, globose inflato, glabrescente differt.

Herba diffusa, ramis striatis, parcissimo adpresso-pubescentibus, ad 50 cm. longis, internodiis 1·5—2 cm. longis; stipulae subulatae, vix 0·2 cm. longae; folia adscendentia, ad 12 cm. longa, petiolo 1·5—2·5 cm. longo, foliolis 4—9-jugis, oblongo-obovatis vel obovatis, apice excisis, basi subcuneatis, supra glabrescentibus, infra adpresso-pubescentibus, 0·8—1·8 cm. longis, 0·5—0·7 cm. latis; pedunculi suberecti, foliis multo breviores, 1—2 cm. longi, apice 3—4-flori, floribus adscendentibus; bracteae ovato-lanceolatae, 0·2 cm. longae; calyx pedicellum nigro-pubescentem aequans, intus glaber, extus nigro-pubescens, 0·3—0·4 cm. longus, segmentis inter se latitudine valde inaequalibus, anterioribus lanceolatis, ceteris ovatis, acutis, tubo aequilongis; vexillum 0·6 cm. longum, lamina reniformi, 0·4 cm. longa; alae vexillo aequilongae, lamina obtusa, anteriore basi obscure lobata, lobo posteriore patente rotundato, 0·4 cm. longa; carina obtusa, 0·5 cm. longa, ungue fere laminam aequante; ovarium anguste semi-ellipticum, adpresso-pubescens pluriovulatum, stylo circum stigma barbato; legumen globose inflatum glabrescens, ad 2·5 cm. diam., seminibus 3—5.

Cape Province: South-western Region; Malmesbury Div., in grassy places nr. Groene Kloof (Mamre), alt. 300 ft., fl. Oct., *Bolus,* 4274.

Near *L. prostrata,* DC., but differs in having adpressed indument, peduncles much shorter than the leaves, larger, globosely inflated, glabrescent legume. Plate X, B.

L. Thodei, n. sp., *L. argenteae* proxima, sed calycis segmentis longioribus, legumine oblique late obovato brevioreque distinguitur.

Herba diffusa, ramis elongatis pallidis, novellis albido-hispidis, aliter glabris, ad 25 cm. longis, internodiis 1·5—2·5 cm. longis; stipulae oblique ovatae acuminatae, 0·4 cm. longae; folia adscendentia, 3—4 cm. longa, petiolis 0·5—1 cm. longis, foliolis 6—9-jugis obovato-oblongis obtusis, 0·5—0·6 cm. longis, 0·2—0·3 cm. latis; pedunculi foliis saepius duplo longiores, hispiduli, supra medium 5—7-flori, floribus adscendentibus vel patentibus; bracteae ovato-lanceolatae, pedicellis duplo breviores; pedicelli albido-hispidi, 0·5—0·6 cm. longi; calyx pedicellis subaequilongus, hispidus, segmentis acutis, intus tomentosis, tubo aequilongis; vexillum 0·9 cm. longum; alae subfalcatae obtusae, lobo posteriore rotundato, 0·8 cm. longae; carina alis aequilonga obtusa, ungue fere laminam aequante; ovarium sericeo-villosum pluriovulatum, stylo circum stigma barbato; legumen subcompressum, oblique late obovatum, parcissime hispidulum, stipite incluso, 1·8—1·9 cm. longum, 1·1 cm. latum.

Natal: Eastern Mountain Province Region; summit of Mont-aux-Sources, alt. 9800 ft., fl. Jan., *H. G. Flanagan,* 1939; same locality, fl. Jan., *J. Thode,* 12.

Near *L. argentea,* Harv., but differs in having longer calyx-segments, an obliquely broadly obovate and shorter legume and in being glabrescent. Plate XI, A.

L. Kensitii, n. sp., *L. stenolobae,* proxime accedit sed stipulis majoribus, racemis elongatis, bracteis foliaceis multo majoribus differt.

Herba perennis (?) diffusa, parce appresseque hispida, ramis decumbentibus, saepius simplicibus, elongatis, ad 40 cm. longis internodiis 2·5—5·5 cm. longis; folia patentia brevipetiolata, stipulis oblique ovatis, acuminatis, 0·5—1 cm. longis, foliolis 6—9-jugis linearibus, marginibus involutis, supra glabris, 0·8—1·2 cm. longis, ad 0·2 cm. latis; pedunculi elongati, ad 10 cm. longi, racemis subdense multi-floris, ad 9 cm. longis; bracteae foliaceae, ovatae vel ovato-lanceolatae, acutae, 0·5—1 cm. longae, bracteolis linearibus acutis, 0·25 cm. longis; pedicelli 0·3 cm. longi; calyx 0·4 cm. longus, segmentis subacutis, tubo multo brevioribus; petala inter se subaequalia, 1—1·1 cm. longa, lilacina luteo-notata; ovarium lineare sericeum, ad 10 ovulatum, 0·6 cm. longum, 0·1 cm. latum, stylo circum stigma intusque per dimidium longitudinis barbato; legumen immaturum subfalcatum.

Cape Province: South-eastern Region; Humewood, nr. Port Elizabeth, alt. circa 20 ft., fl. Sept., *E. Kensit*, 3.

Very closely allied to *L. stenoloba*, E. Mey., but differs in having larger stipules, elongated racemes, and much larger foliaceous bracts. Plate XI, C.

Legume suborbicular, elliptic oblong, obliquely obovate, or obliquely obovate-oblong, usually < twice as long as broad, or very rarely slightly longer.
Ovary and legume glabrous or very nearly so.
Peduncles spinescent or rigid.
Carina much shorter than alae. 2. *spinescens*, E. Mey.
Carina about as long as alae.
Legume obovate-oblong.
Pedicel and calyx nigro-pubescent; leaflets not cano-tomentose. 3. *rigida*, E. Mey.
Pedicel and calyx cano-pubescent; leaflets cano-tomentose. 9. *incana*, Schinz.
Legume suborbicular. 4. *margaritacea*, E. Mey.
Peduncles not spinescent or rigid.
Racemes usually 2—6-fld.
Racemes shorter than the leaves.
Pubescence of soft hairs. 24. *inflata*, Harv.
Pubescence strigose on stem and leaves.
Legume globosely inflated; carina shorter than alae. 31. *globosa*, L. Bolus.
Legume not globosely inflated; carina about as long as alae.
Leaflets conspicuously emarginate. 10. *emarginata*, Schinz.
Leaflets not conspicuously emarginate.

Legume obliquely broad-obovate. 1. *brachypus*, Harv.
Legume obliquely broad-oblong.
11. *benguelensis*, Baker.
Racemes longer than the leaves.
Pubescence of soft hairs. 25. *microcarpa*, E. Mey.
Pubescence strigose on stem and leaves.
Carina about as long as alae. 14. *Harveyana*, L. Bolus.
Carina much shorter than alae. 22. *Flanaganii*, L. Bolus.
Racemes usually many-fld.
Legumes conspicuously inflated, usually membranous.
Leaflets 4—9-jugate.
Legume semi-lunate; pubescence of long soft spreading hairs.
29. *excisa*, DC.
Legume not semi-lunate; pubescence strigose on stem and leaves.
Peduncles longer than leaf. 19. *physodes*, E. and Z.
Peduncles shorter than leaf. 21. *depressa*, Harv.
Leaflets 10—14-jugate. 20. *tenuifolia*, E. Mey.
Legumes more or less compressed, usually not membranous.
Pubescence strigose on stem and leaves.
More or less rigid and erect.
Legume obliquely obovate-oblong.
Pedicel and calyx nigro-pubescent; fls. about 5 ls. long.
3. *rigida*, E. Mey.
Pedicel and calyx albo-pubescent; fls. < 5 ls. long.
13. *stricta*, Bolus.
Legume suborbicular or broadly obovate.
12. *fruticosa*, Lindl.
More or less herbaceous, decumbent or trailing.
Racemes lax; legume < 1 in. long; annual?
15. *linearis*, DC.
Racemes dense; legume 1 in. or more long; perennial.
Leaflets 5—6-jugate; legume 16—20-seeded.
16. *subumbellata*, Harv.
Leaflets 6—14-jugate; legume 4—6-seeded.
17. *pulchra*, Sims.
Pubescence of long soft spreading hairs.
More or less shrubby and erect.
Branches short, twiggy; calyx-lobes deltoid, shorter than the tube. 5. *flexuosa*, E. Mey.
Branches long, virgate; calyx-lobes not as above.
Plant thinly silky. 6. *perennans*, DC.

Plant villoso-canescent. 6. *perennans*, DC. var. *polystachya*.
More or less herbaceous, decumbent or trailing.
Raceme elongating; legume suborbicular. 26. *diffusa*, R. Br.
Raceme not elongating; (legume unknown). 23. *capitata*, E. Mey.
Ovary and legume pubescent.
Style bearded ventrally for half its length.
Leaflets complicate with involute margins, appearing terete and furrowed above; calyx-segments much shorter than tube. 34. *carnosa*, E. and Z.
Leaflets not as above; calyx-segments equalling or longer than tube. 29. *Dykei*, L. Bolus.
Style bearded round base of stigma.
Peduncle spinescent; legume spotted with purple. 7. *macrostachya*, DC. var. *atomaria*.
Peduncle and legume not as above.
Racemes longer than the leaf.
Flowers distant (½—1½ in. apart); terminal leaflet much larger than lateral. 7. *macrostachya*, DC.
Flowers and terminal leaflet not as above.
Legume inflated; carina shorter than alae. 28. *tomentosa*, DC.
Legume ± compressed; carina about as long as alae.
Herbaceous; pedicels about as long as the calyx.
Legume elliptic-oblong, 1 in. or more long; silvery pubescence copious. 32. *argentea*, Harv.
Legume obliquely broad-obovate, < 1 in. long; pubescence scanty. 33. *Thodei*, L. Bolus.
Frutescent; pedicels much longer than calyx. 6. *perennans*, DC. var. *sericea*.
Racemes shorter than leaf.
Shrubby, erect, villoso-canescent. 8. *candida*, E. Mey
Herbaceous, procumbent, sparingly-hispid. 30. *prostrata*, DC.
Legume linear or oblong, usually > twice as long as broad.
Ovary and legume glabrous or the sutures ciliate with silky hairs.
Vexillum 0·9 cm. long. 40. *stipulata*, Bak. f.
Vexillum 1·6 cm. long. 18. *Pappeana*, Harv.
Ovary densely silky.
Stipules and bracts up to 1 cm. long. 39. *Kensitii*, L. Bolus.
Stipules and bracts up to 0·5 cm. long.

Pedicels longer than calyx. 35. *brachystachya*, DC.
Pedicels shorter than calyx.
Peduncles much longer than leaf. 38. *stenoloba*, E. Mey.
Peduncles much shorter than or scarcely longer than leaf.
Usually slender, herbaceous; legume strongly arched, annular, or spirally twisted. 41 *annularis*, Burch.
Usually suffruticose; legume falcate or nearly straight.
Style not bearded ventrally below the apex; often woody and erect. 36. *falciformis*, DC.
Style bearded ventrally for nearly half its length; usually dwarf and prostrate. 37. *pauciflora*, Harv.

# FLOWERING PLANTS AND FERNS COLLECTED ON THE GREAT KARASBERG BY THE PERCY SLADEN MEMORIAL EXPEDITION, 1912–1913[1].

By F. BOLUS, L. BOLUS and R. GLOVER.

(*Continued from page* 75)

## SOLANACEAE

Solanum capense, Linn., forma. *Western Karasberg.* Sandy bank of dry shallow stream bed 5 miles S.E. of Wasserfall, 7954.

Solanum giftbergense, Dunal, forma. *Eastern Karasberg.* Narudas Süd, 7955.

Solanum Rangei, U. Damm. *Western and Eastern Karasberg.* Ravine 100 ft. above Wasserfall Alt, 7956; ravine, Narudas Süd, 8127.

Withania somnifera, Dunal. *Central and Eastern Karasberg.* Hills above Krai Kluft, 8266; common among boulders near head of ravine, Krai Kluft, 8205.

Lycium namaquense, U. Damm. *Central and Eastern Karasberg.* Among rocks at bottom of Krai Kluft Ravine, 7958; on steep slopes, Narudas Süd, 8130.

Lycium karasbergense, L. Bolus, n. sp., *L. cinereo* accedit sed foliis saepissime angustioribus, pedicellis longioribus, calyce majore, lobis tubo subaequantibus, corollae lobis rotundatis, tubo aequilongis.

Suffrutex rigidus glaber, 0·25—0·50 met. altus; rami ramulique saepe flexuosi spinescentes, cortice griseo vel demum atropurpurascente, ultimi 1·5—3·5 cm. longi; folia 3—6-fasciculata, linearia, vel lineari-spathulata, ad 1 cm. longa, 0·1 cm. lata; pedicelli 0·3—0·5 cm. longi; calyx 0·5—0·6 cm. longus, segmentis subinaequalibus lanceolatis vel ovato-lanceolatis, acutis ciliolatis, 0·2—0·3 cm. longis; corolla 0·8 cm. longa lilacina, segmentis obovatis rotundatis eciliatis, 0·4 cm. longis, 0·3 cm. latis; stamina inter se aequalia vel fere aequalia, manifesta, corolla breviora, tubi medio adnata, filamentis basi barbatis; ovarium glabrum, 0·1 cm. longum, stylo manifesto; bacca haud visa.

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[1] *Percy Sladen Memorial Expeditions in South-West Africa, Report No.* 70 (*continued*).

*Central and Eastern Karasberg.* River bed between Krai Kluft and Narudas Süd, 8104. Lower slopes, among boulders, Narudas Süd, 8133. Sandy plains N.E. of Narudas Süd, 8143.

Allied to *L. cinereum*, Thunb., but the leaves are usually narrower, pedicels longer, calyx larger with the lobes about as long as the tube, lobes of the corolla rounded, as long as the tube. Plate XIII, A.

### SCROPHULARIACEAE

Aptosimum albomarginatum, Marl. and Engler. *Central Karasberg.* Dry sandy river channels S.W. of Krai Kluft, 7949.

Aptosimum abietinum, Burch. *Western and Central Karasberg.* Wasserfall Alt Ravine, 8254; stony slopes S.W. of Krai Kluft, 7950.

Peliostomum leucorrhizum, E. Mey. *Central and Eastern Karasberg.* Outspan between Krai Kluft and Narudas Süd, river bed, 8087; sandy hollows in granite slopes, Narudas Süd, 8176; sandy plains N.E. of Narudas Süd, 8148.

Anticharis linearis, Hochst. *Western Karasberg.* Sandy bed, Wasserfall Alt Ravine, 7944.

Anticharis scoparia, Hiern. *Western Karasberg.* Rocky slopes of ravine, Wasserfall, 8081; crevices in rocks Wasserfall Alt Ravine, 7947.

Nemesia karasbergensis, L. Bolus, n. sp., *N. coeruleae* accedit sed ramis superne nec pedunculoideis, labio anteriore infra palatum nec 2-gibboso, omnibus partibus, praecipue calcare brevissimo, minoribus.

Herba perennis, e basi ramosa, ad 20 cm. alta; rami stricti erecti vel suberecti quadrangulares, internodiis 1·5—3 cm. longis, cum foliis pedicellis sepalisque viscidulo-hispiduli; folia adscendentia vel patentia, sessilia vel subpetiolata, lanceolata vel ovata, acuta serrata, 0·7—1·5 cm. longa; racemi laxiuscule pluri-fl., floribus adscendentibus; pedicelli demum 1 cm. longi; calyx subbilabiatus, 0·4 cm. longus segmentis posterioribus lineari-lanceolatis acutis, anterioribus subovatis; corolla extus hispidula, dilute coerulea, fauce lutea, labio anteriore emarginato, ad basin obtusam calcaris 1 cm. metiente, limbo 0·5 cm., calcare vero 0·1 cm. longo, labii posterioris lobis fere aequalibus, oblongis obtusissimis, 0·2 cm. longis; capsula oblonga emarginata, basi subobliqua, 0·7 cm. longa, 0·3 cm. lata.

*Central Karasberg.* Summit of Scharfenstein, 7000 ft., 7952.

Allied to *N. coerulea*, Hiern., but differs in not having the branches pedunculoid upwards, nor the anterior lip 2-gibbous in the tube below the palate. All the parts are smaller, especially the very short spur, which reaches 0·3 cm. long in some of the flowers of *Wood,* 4196. Plate XIII, B.

Sutera atropurpurea, Hiern. *Central Karasberg.* Summit of Scharfenstein, 7945.

Sutera tomentosa, Hiern. *Western and Eastern Karasberg.* Damp partially shady places in Wasserfall Alt Ravine and at Narudas Süd, 7946.

Sutera canescens, Hiern. *Western and Eastern Karasberg.* Rocky places near water hole, Wasserfall Alt, 8248; near water, Narudas Süd Ravine, 8124.

Sutera rigida, L. Bolus. *Central and Eastern Karasberg.* Krai Kluft Ravine, 8284; Narudas Süd, 8133.

Manulea namaquana, L. Bolus, n. sp., *M. cephaloti* affinis, sed foliis saepissime oppositis, crassioribus ovatis, ovato-oblongis, obovatis vel subflabelliformibus, irregulariter dentatis vel lobulatis, corollae lobis majoribus differt.

Herba rigida, minute glandulosa, glaucescens, ad 30 cm. alta; rami e basi erecti vel adscendentes, subgraciles, ad 0·3 cm. diam., internodiis 1·4—4 cm. longis; folia erecta vel patentia, opposita vel superiora alterna, ovata, ovato-oblonga, obovata vel subflabelliformia. obtusa vel subacuta, basi oblique cuneata, in petiolum attenuata, dentata vel lobulata, 1—2 cm. longa, 0·5—0·9 cm. lata; flores cymoso-paniculati vel quasi racemosi, erecti vel subpatentes; bracteae lineari-lanceolatae, pedicellos 0·3—0·4 cm. longos parum excedentes; calyx 5-partitus, segmentis anguste linearibus ciliolatis, 0·3—0·4 cm. longis; corolla hypocrateriformis, tubo subflexuoso, 1 cm. longo, 0·1—0·2 cm. diam., lobis suborbicularibus, marginibus revolutis, 0·3 cm. longis; ovarium glabrum, 0·15 cm. longum, stylo apice breviter bilobo, 0·2 cm. longo; capsula oblongo-ovata obtusa, subobliqua, 0·5 cm. longa.

*Central Karasberg.* In rock crevices, summit of Scharfenstein, 7953.

Near *M. cephalotes,* but differs in having the leaves mostly opposite, thicker in texture, differently shaped, irregularly dentate or lobulate and the lobes of the corolla larger. Plate XIII, C.

A plant collected by Dr R. Marloth (No. 5008) near Aus is the same species.

Striga orobanchoides, Benth. *Eastern Karasberg.* Narudas Süd Ravine, 8122.

## BIGNONIACEAE

Rhigozum obovatum, Burch. *Central and Eastern Karasberg.* On steep krantz overlooking ravine, Krai Kluft, 8198; on stony hillsides, Baviaanspforte, 8159; shale hills 8 km. N.E. of Narudas Süd, 8154.

## PEDALINEAE

Pterodiscus luridus, Hook. f. *Central and Eastern Karasberg.* High plateau between Krai Kluft and Narudas Süd, 8107.

Harpagophytum procumbens, DC. *Western Karasberg.* Sandy locality in granite plateau between Dassiefontein and Noachabeb, 8541.

Rogeria longiflora, Gay. *Western Karasberg.* Crevices in rocky sides, Wasserfall Alt Ravine, 8540.

Sesamum capense, Burm. f. *Central Karasberg.* Sandy slopes S.W. of Krai Kluft, 8542.

## ACANTHACEAE

Petalidium linifolium, Harv. *Western Karasberg.* Banks of dry stream beds on high plateau 5 miles S.E. of Wasserfall, 7997.

Blepharis diversispina, C. B. Cl. *Eastern Karasberg.* River bed, Narudas Süd, 8243.

Barleria Lichtensteiniana, Nees. *Western and Central Karasberg.* High plateau between Wasserfall and Krai Kluft, 8249.

Barleria lancifolia, T. Anders., forma. *Western and Eastern Karasberg.* Rocky sides of ravine, Wasserfall Alt, 7993; crevices in sandstone in Keiap R. bed, Narudas Nord, 7994.

Barleria irritans, Nees, var. rigida. *Eastern Karasberg.* Narudas Süd, crevices in sandstone in bed of Keiap R., 7996.

Barleria stimulans, E. Mey. *Central and Western Karasberg.* In crevices in quartz vein on high plateau between Krai Kluft and Wasserfall, 7995.

Monechma spartioides, C. B. Cl. *Western, Central and Eastern Karasberg.* Wasserfall Alt and Krai Kluft, 8128; sandstone cliffs, Narudas Süd, 7991; Upper Keiap R., among stones, 8454; on upper western slopes, Narudas Süd, 8453, 7992.

Monechma incanum, C. B. Cl. *Eastern Karasberg.* Banks of Keiap R. below Narudas Süd, 8239; sandy plains N.E. of Narudas Süd, 8152.

Monechma leucodermis, C. B. Cl. *Western, Central and Eastern Karasberg.* In sand in dry watercourse above Wasserfall Alt Ravine, 7998; in crevices in quartz vein on high plateau between Wasserfall and Krai Kluft, 7999; among rocks, Narudas Süd, 8334; banks of Keiap R. below Narudas Süd, 8241.

Monechma molle, C. B. Cl., var. foliis glabrescentibus. *Western Karasberg.* Sandy dry stream beds on high plateau S.E. of Wasserfall, 8450.

Monechma desertorum, C. B. Cl. *Central Karasberg.* Stony slopes S.W. of Krai Kluft, 8451.

## SELAGINEAE

Selago albida, Choisy. *Western and Central Karasberg.* A few feet above Wasserfall Alt water hole, 8466; sandstone plateau on summit of Scharfenstein E. of Krai Kluft, 8467; summit of Scharfenstein, 8468.

## VERBENACEAE

Bouchea pinnatifida, Schauer. *Central and Eastern Karasberg.* Near foot of high plateau N. of Krai Kluft, 8200; sandy plains, Narudas Süd, 8329; Narudas Süd Ravine, 8123; river bed, in sand, Narudas Süd, 8335.

Bouchea glandulifera, H. H. W. Pearson. *Eastern Karasberg.* Narudas Süd Ravine, 8534.

## LABIATAE

Ocimum fruticulosum, Burch. *Central and Eastern Karasberg.* Near water, Krai Kluft, 8510; among rocks in river bed, Narudas Süd, 8233.

Salvia gariepensis, E. Mey. *Central and Eastern Karasberg.* Lower slopes of Scharfenstein, 8509; lower stony slopes, Narudas Süd, 8135.

Acrotome pallescens, Benth. *Central and Eastern Karasberg.* Camel path between Krai Kluft and Narudas Süd and Narudas Süd, 8508.

Stachys rugosa, Ait. *Western, Central and Eastern Karasberg.* Wasserfall Alt Ravine, 8504; summit of Scharfenstein, 8505; on granite slopes, Narudas Süd, 8168.

Lasiocorys capensis, Benth. *Western and Eastern Karasberg.* Banks of shallow dry sandy stream beds on high plateau 5 miles S.E. of Wasserfall, 8506.

## NYCTAGINEAE

Boerhaavia bracteata, T. Cooke. *Eastern Karasberg.* Keiap River bed, Narudas Süd, 8174.

Boerhaavia repens, var. diffusa, Hook. f. *Western Karasberg.* On steep loose shale slopes of Wasserfall Alt Ravine, 8473.

Boerhaavia hereroensis, Heimerl. *Western Karasberg.* On steep loose shale slopes of Wasserfall Alt Ravine, 8474.

Phaeoptilon spinosum, Radl. *Western and Eastern Karasberg.* In sandy ravine on western side, Wasserfall, 8074; common in sandy river bed, Wasserfall, 8076, 8255; stony slopes west of Baviaanspforte, 8161.

## ILLECEBRACEAE

Pollichia campestris, Soland. *Eastern Karasberg.* In crevices in sandstone above pool, Narudas Süd, 8545.

## AMARANTACEAE

Sericocoma pungens, Fenzl. *Central Karasberg.* Stony slopes S.W. of Krai Kluft, 8543.

Sericocoma avolans, Fenzl. *Eastern Karasberg.* In sand, Narudas Süd, 8312.

Marcellia Bainesii, C. B. Cl. *Eastern Karasberg.* Foot of sandstone cliffs, Narudas Süd, 8544.

## PHYTOLACCACEAE

Microtea Burchellii, N. E. Br. *Eastern Karasberg.* Sandy places among granite foothills, Narudas Süd, 8323; sandy places N.E. of Narudas Süd, 8150.

## LORANTHACEAE

Loranthus namaquensis, Harv. *Western Karasberg.* Wasserfall Alt Ravine, 8080.

Viscum pauciflorum, Thunb. *Western Karasberg.* Wasserfall Alt, 8077.

## EUPHORBIACEAE[1]

Euphorbia gariepina, Boiss. *Western Karasberg.* Characteristic of quartz stream slopes, 5 miles S.E. of Wasserfall, 7811. Very common on western slopes, Wasserfall, 8075. *Western, Central and Eastern Karasberg.* High plateau between Wasserfall and Krai Kluft, 8259. High plateau between Krai Kluft and Narudas Süd, 8118. Very common on high sandstone plateau between Krai Kluft and Narudas Nord (camel path), 7810. On sandstone, Narudas Süd, 8228.

Euphorbia virosa, Willd. *Western Karasberg.* Common on slopes, Wasserfall, 8085, 8022.

Euphorbia gregarica, Marl. *Western Karasberg.* Very common on lower slopes, Wasserfall, 8084.

Euphorbia lignosa, Marl. *Central Karasberg.* Hill slopes facing W., S. of Krai Kluft, 8110.

Euphorbia decussata, E. Mey. *Western, Central and Eastern Karasberg.* High plateau between Wasserfall and Krai Kluft, 8258. Lower stony slopes, Krai Kluft, 8117. Rocks above camel path between Narudas Süd and Krai Kluft, 8347.

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[1] By N. E. Brown.

Euphorbia mauritanica, Linn. var. *Central and Eastern Karasberg.* Granite slopes opposite Krai Kluft, 8344, 8345. Krai Kluft Ravine, 8279. Among rocks on lower slopes, Narudas Süd, 8346.

### URTICACEAE

Ficus cordata, Thunb. *Western and Eastern Karasberg.* Steep sides, Wasserfall Alt Ravine, 8079, 8547. Foothills in ravine, Narudas Süd, 8162; lower slopes, Narudas Süd, 8136.

### AMARYLLIDACEAE

Nerine lucida, Herb. *Eastern Karasberg.* Stony ground, sandstone plateau, Narudas Süd, 8330.

Vellozia viscosa, Baker. *Eastern Karasberg.* Granite and dolerite in torrent bed, Narudas Süd, 8455.

### LILIACEAE

Asparagus Burkei, Baker. *Eastern Karasberg.* In sand flats, Narudas Süd, 7962.

Asparagus stipulaceus, Lam. *Central and Eastern Karasberg.* Rough sandstone slopes between Narudas Nord and Krai Kluft, 7963.

Asparagus africanus, Lam. var. γ, microphyllus, Burch. *Eastern Karasberg.* Narudas Süd, 7964.

Asparagus racemosus, Willd. var. tetragonus, Baker. *Eastern Karasberg.* Sandstone on western slopes, Narudas Süd, 8220.

Asparagus exuvialis, Burch. *Central and Eastern Karasberg.* High plateau between Krai Kluft and Narudas Süd, among stones, 8101. River valley S. of Zandmund, 8158.

Asparagus striatus, Thunb. *Central Karasberg.* On steep slope N. of ravine, 5300 ft., Krai Kluft, 8199.

Asparagus abyssinica, Hochst. *Western Karasberg.* Wasserfall Alt Ravine, 7965. – A pear[illegible]

Aloe striata, Haw. *Eastern Karasberg.* Sandstone kopje E. of Narudas Süd, 7966.

Schizobasis intricata, Baker. *Eastern Karasberg.* Sandstone plateau, Narudas Süd, 8303. Among rocks, banks of the Keiap R. below Narudas Süd, 8238.

Eriospermum Burchellii, Baker. *Eastern Karasberg.* Sandy hollows in eastern slopes, Narudas Süd, 8171.

Eriospermum bechuanicum, Baker. *Eastern Karasberg.* Sandy plains N.E. of Narudas Süd, 8140. Sand flats, Narudas Süd, 7967.

Eriospermum Bellendeni, Sweet. *Central Karasberg.* Sandstone slope 5 km. S. of Krai Kluft, 8227.

Eriospermum corymbosum, Baker. *Central and Eastern Karasberg.* Dry pan on high plateau between Krai Kluft and Narudas Süd, 8096.

Eriospermum roseum, Schinz. *Central and Eastern Karasberg.* In deep sand on plains, 5000 ft., Krai Kluft, 8292. Sandy plains N.E. of Narudas Süd, 8137. Sandy places among granite foothills, Narudas Süd, 8324.

Eriospermum brevipes, Baker. *Eastern Karasberg.* Sandy plains, Narudas Süd, 7968.

Anthericum malosanum, Baker. *Central Karasberg.* Middle slopes, Scharfenstein, 7969.

Anthericum pubescens, Baker. *Western Karasberg.* Sandy plains N. of Noachabeb, 7970.

Tulbaghia karasbergensis, Glover, n. sp., *T. acutilobae* affinis sed bulbo majore, segmentis perianthii longioribus magisque acuminatis, corona breviore, distinguitur.

Bulbus globosus, tunicis membranaceis fulvis, 2—3 cm. longus, 2—2·5 cm. diam., in collum 4·5 cm. longum attenuatus; folia 4—7, linearia obtusa glabra, 13—24 cm. longa, 0·3—0·5 cm. lata; pedunculus gracilis, 20—25 cm. longus, umbella 7—12-fl.; spathae valvae ovatae acuminatae membranaceae; pedicelli ad 3·5 cm. longi; perianthium viride, tubo 0·6—0·7 cm. longo, segmentis lineari-lanceolatis acuminatis, 0·8—1 cm. longis; corona annularis lutea, 0·1 cm. alta; capsula ovali-oblonga, 1 cm. longa, 0·6 cm. diam.

*Central and Eastern Karasberg.* Krai Kluft, common among stones not far above the bed of stream, 8192. Narudas Süd, 8234.

Nearest *T. acutiloba*, Harv., from which it differs by its larger and differently-shaped bulb, longer and more acuminate perianth segments and shorter corona.

Dipcadi Clarkeanum, Schinz. *Central and Eastern Karasberg.* Sandstone plateau on summit of long hill E. of Krai Kluft, 7971. Sandy places in lower foothills, Narudas Süd, 8165. Sandstone plateau and sandstone flats, Narudas Süd, 8296, 8231, 7981.

Dipcadi hyacinthoides, Baker. *Eastern Karasberg.* Sandstone plateau, Narudas Süd, 8304.

Dipcadi crispum, Baker. *Eastern Karasberg.* Sandy plains, Narudas Süd, 7976.

Dipcadi crispum, Baker? *Central and Eastern Karasberg.* Stony plains S.W. of Krai Kluft, 7977. Steep slopes facing N.W., Narudas Süd, 8297.

Dipcadi viride, Moench. *Eastern Karasberg.* Sandstone plateau 4 miles W. of Narudas Süd, 7978.

Dipcadi Dinteri, Schinz. *Eastern Karasberg.* Sandstone nek, Narudas Süd, 8299.

Dipcadi brevipes, Baker. *Eastern Karasberg.* Coarse sand on plains, sandy hollow in dry river bed, and in sandstone, Narudas Süd, 7979, 8319, 7980.

Dipcadi longibracteatum, Schinz. *Western Karasberg.* Loose steep shale slopes of Wasserfall Alt Ravine, 7982.

Dipcadi glaucum, Baker. *Eastern Karasberg.* Clefts in granite in foothills, Narudas Süd, 7983.

Dipcadi ciliare, Baker, var. ciliolata, nov. var. *Eastern Karasberg.* Sandy plains and in sand by river bed, Narudas Süd, 8311, 8328.

Dipcadi sp. Near D. anthericoides, Engl. and Gilg and D. longifolium, Baker. *Western, Central and Eastern Karasberg.* Sandstone slopes 500 ft. above Wasserfall Alt Ravine, 7974. Lower slopes, Scharfenstein, 7975. Lower eastern granite slopes, Narudas Süd, 7972.

Dipcadi sp. *Eastern Karasberg.* Sandstone plateau 4 miles E. of Narudas Süd, 7973.

Albuca karasbergensis, Glover, n. sp. *A. angolensi* affinis, sed foliis brevioribus, pedunculo breviore tenuioreque, racemo multo densiore, floribus minoribus et bracteis longe caudatis distinguitur.

Bulbus ignotus; folia 4, lanceolata, acuminata, glabra, basi vaginantia, circa 49 cm. longa, 2·5—3 cm. lata; pedunculus teres, glaber, ad 60 cm. altus; racemus valde densus, 13 cm. longus; bracteae ovatae, longe caudatae, membranaceae, 3—5 nervatae, 2·5 cm. longae, basi 1 cm. latae, floribus longiores, apice eomam formantes; pedicelli 0·2 cm. longi, floribus adscendentibus, segmenta perianthii albida dorso late viridi-vittata 6-nervata, ad 2 cm. longa, 0·5—0·6 cm. lata; stamines omnes fertiles, filamentis basi dilatatis, infra medium marginibus involutis, 1·2 cm. longis, antheris uniformibus, 0·5 cm. longis; ovarium ovato-oblongum, breve stipitatum, 0·4 cm. longum, stylo filiformi, 1 cm. longo, stigmate capitato; capsula haud visa.

*Western Karasberg.* Steep western slopes of granite hill 5 miles S.E. of Wasserfall Alt, 7985.

Nearest to *A. angolensis,* Baker, but differs in having shorter leaves, shorter and more slender peduncle, much denser raceme, smaller flowers and long caudate bracts.

Hyacinthus sp. (material insufficient). *Central and Eastern Karasberg.* High plateau between Krai Kluft and Narudas Süd, 8121.

Scilla lanceaefolia, Baker? *Western and Central Karasberg.* High plateau between Wasserfall and Krai Kluft, 8257.

Scilla Nelsoni, Baker. *Eastern Karasberg.* Sandy plains, Narudas Süd, 7990.

Scilla Pearsonii, Glover, n.sp. Affinis *S. Nelsoni, Baker,* sed tunicis permultis rigidis, foliis duobus, floribus minoribus albidisque distinguitur.

Bulbus globosus, 1·5—2 cm. in diam., tunicis permultis rigidis fulvis; folia 2, lineari-lanceolata acuta glabra, 5·5—8·5 cm. longa, 0·3—0·4 cm. lata; racemus densus, circa 2 cm. longus, 1 cm. in diam., pedunculo foliis aequilongo vel paulo longiore, pedicellis erecto-patentibus, 0·4 cm. longis; perianthium supra basin patens, albidum, apice brunneo-coeruleo-notatum, segmentis lineari-oblongis acutis, 0·4 cm. longis, 1·5 cm. latis; filamenta perianthium aequantia vel paulo excedentia; ovarium sessile, stylo subulato, 0·25 cm. longo.

*Central Karasberg.* Scharfenstein, middle slopes on sandstone, 7989.

Allied to *S. Nelsoni,* Baker, but is distinguished from that species in having the bulb furnished with numerous rigid tunics, only two leaves, and smaller whitish flowers.

Scilla sp. (material insufficient). *Eastern Karasberg.* Stony flat on right bank of Keiap R., Narudas Süd, 8306.

Ornithogalum Zeyheri, Baker. *Eastern Karasberg.* Narudas Süd, 7987.

Ornithogalum prasinum, Lindl. *Eastern Karasberg.* Sandstone, Narudas Süd, 8225.

Ornithogalum karasbergense, Glover, n. sp., affine *O. polyphlebio* (e descriptione), sed pedicellis brevioribus, perianthii segmentis 3—5 nervatis, filamentis omnibus infra medium quadrato-dilatatis, distinguitur.

Bulbus 2—3 cm. in diam., tunicis membranaceis, circa 8 cm. longis; folia linearia vel lineari-lanceolata, glabra, 16 cm. longa, 0·2—0·3 cm. lata; racemus densus, ad 6 cm. longus, pedunculo glabro, ad 16 cm. longo, pedicellis erecto-patentibus glabris, ad 1·2 cm. longis; bracteae ovatae acuminatae scariosae, ad 1·5 cm. longae; perianthium 1·5 cm. in diam., segmentis ovatis-oblongis obtusis albidis viridi-carinatis 3—5 nervatis, 0·7 cm. longis; filamenta omnia infra medium quadrato-dilatata, 0·5 cm. longa, basi 0·2 cm. lata; discus 6-crenatus, ovario adnatus; ovarium brevi-stipitatum.

*Eastern Karasberg.* Sandy plains N.E. of and at Narudas Süd, 8144, 7986.

Near *O. polyphlebium,* Baker, but is distinguished by its shorter pedicels, perianth-segments 3—5 nerved, and all the filaments being dilated at the base.

## NAIADACEAE

Aponogeton Rehmanni, Oliver, var. major, Glover, nov. var. *Eastern Karasberg.* In Keiap R. about 4 miles above military station, Narudas Süd, 8456, 8457.

## CYPERACEAE

Kyllinga alba, Nees. *Eastern Karasberg.* Sandy flats, Narudas Süd, 8561.

Mariscus congestus, C. B. Cl. *Eastern Karasberg.* In clefts in granite foothills, 8562.

Cyperus longus, Linn. *Eastern Karasberg.* Wet sand in Keiap R., Narudas Süd, 8563; river-bed, Narudas Süd, 8232.

Fimbristylis exilis, R. and S., forma depauperata (fide W. B. Turrill). Exact locality uncertain. 8560.

## GRAMINEAE

Andropogon Ischaemum, Linn. var. radicans, Hack. *Eastern Karasberg.* Sandstone plateau, Upper Keiap, 8501. Sandstone on upper slopes, Narudas Süd, 8179.

Heteropogon contortus, R. and S. *Eastern Karasberg.* On granite on lower eastern slopes, Narudas Süd, 8502.

Cymbopogon plurinodis, Stapf. *Central Karasberg.* Near water at Krai Kluft, 8503.

rda Anthistiria imberbis, Retz. *Eastern Karasberg.* Sandstone on summit, Narudas Süd, 8224.

Digitaria eriantha, Steud. *Central Karasberg.* Krai Kluft, 8516.

Panicum mesocomum, Nees. *Great Karasberg,* 8519.

Panicum maximum, Jacq. *Central and Eastern Karasberg.* Ravines at base of Scharfenstein, and at Narudas Süd, 8517.

Panicum minus, Stapf, var. β planifolium, Stapf. *Central and Eastern Karasberg.* On granite in ravine at base of Scharfenstein, 8520. On granite on lower slopes of Narudas Süd, 8521.

Panicum Pearsonii, Bol. f., n.sp., *P. Meyeriano* affine, sed vaginis basalibus dense floccoso-lanuginosis, culmis tantum 4 nodis, gluma inferiore multo majore 3-nervia, gluma superiore 7-nervia, valva inferiore 9-nervia differt.

Perenne; culmi erecti vel adscendentes, 2—4 nodi, internodiis plus minusve exsertis, teretes striati, nodis lanuginosi, aliter glabri, robustiores, ad 0·5 met. alti; vaginae conspicue striatae, laeves, ore et marginibus versus apicem leviter barbatis, aliquibus capillis inconspicue basi tuberculatis, basales laxiusculae latae pallidae, inferne dense floccoso-lanuginosae, superiores strictiores glabrae, circ. 10 cm. longae; ligula subarcuata, e capillis brevibus composita; laminae planae lineares setaceo-attenuatae laeves glabrae, crebre conspicueque nervosae, ad 25 cm. longae, 0·7 cm. latae; panicula ovata laxiuscula, ad 20 cm. longa, 12·5 cm. diam., axi, ramis ramulisque flexuosis vel substrictis, angularibus striatis, axillis tuberculatis pubescentibus, aliter glabris,

saepissime laevibus vel superne scaberulis, ramis subcrassis vel filiformibus, infimo solitario, ad 11·25 cm. longo, e basi per 1·2—5 cm. simplici, superioribus solitariis vel oppositis vel 2—3 natis, ad 10·5 cm. longis, e basi per 0·5—4 cm. simplicibus, ramulis adscendentibus vel patentibus; pedicelli laterales 2 nati vel solitarii capillares pubescentes, apice discoidei, ad 0·2 cm. longi; spiculae densae, praecipue apicem versus ramorum ramulorumque, oblongae acutae vel subacuminatae, virides, purpureo suffusae, 0·3—0·35 cm. longae; gluma inferior basi late amplectens, subrotunda, acuta vel acuminata, tenue herbacea 3-nervia, 0·2 cm. longa; gluma superior ovata acuta, conspicue 7-nervia, 0·3—0·35 cm. longa; flosculus inferior ♂, valva late ovata subacuta 9-nervia, 0·3 cm. longa, palea oblonga truncata emarginata 2 carinata, valvae aequilonga; flosculus ⚥ oblongus subacutus laevis nitens, 0·3 cm. longus, valva coriacea 7-nervia, antheris 0·2 cm. longis.

*Central Karasberg.* Sandstone plateau on summit of Long Hill, East of Krai Kluft, 8518.

Allied to *P. Meyerianum* but differs in having the basal sheaths densely floccose-lanuginose, the culms only 4-noded, the lower glume much larger, 3-nerved, the upper glume 7-nerved, and the lower valve 9-nerved.

Setaria appendiculata, Stapf. *Western, Central and Eastern Karasberg.* Among granite blocks on high plateau 5 miles east of Wasserfall, 8511. Sandy slopes south-west of Krai Kluft, 8512. Lower foothills, Narudas Süd, 8172. Sandy plains in granite torrent bed, Narudas Süd, 8326.

Pennisetum cenchroides, Rich. *Eastern Karasberg.* Among stones on steep hill-side, Narudas Süd, 8131.

Pennisetum Stapfianum, Bol. f., n.sp., *P. natalensi* proxime accedit, sed multinodium, panicula breviore, gluma inferiore 3-, superiore 5-nervia, valva inferiore 7-nervia.

Perenne; culmi erecti vel e tenuiore sarmentosa rhizomati adscendentes, dimidio inferiore ramosissimi, laeves glabri multi-nodii, internodiis exsertis, ad 40 cm. alti; vaginae striatae laeves glabrae, inferiores laxae, a culmis delapsae, pallidae nitidae, superiores strictiores; ligula e fimbria recta capillorum composita; laminae lineares setaceo-attenuatae, planae vel convolutae, vetustiores spiraliter tortae firmae glabrae subglaucae, ad 18·7 cm. longae, 0·25 cm. latae; panicula spiciformis cylindrica densa erecta, pallidissime viridis, 2·5—4·5 cm. longa, 0·6—0·8 cm. lata; rhachis angularis scabrida; pedicelli brevissimi pubescentes; involucri setae multae tenues pallidae scaberulae inaequilongae, ad 0·5 cm. longae; spiculae solitares oblongo-lanceolatae acuminatae, minute scaberulae, 0·37—0·45 cm.

longae; gluma inferior ovato-lanceolata acuminata 3-nervia hyalina, 0·2 cm. longa; gluma superior ovata acuminata, tenuissime herbacea vel hyalina, 5-nervia, 0·4 cm. longa; flosculus inferior ♂, valva late ovata, acuminata, tenuissime herbacea, 7-nervia, palea 2 carinata elliptica, apice inconspicue 2 loba, lobis inaequalibus, 0·4 cm. longa; flosculus ⚥ ovato-lanceolatus acuminatus, valva mucronata 5-nervia, 0·45 cm. longa, lodiculis cuneiformibus, antheris 0·25 cm. longis, stylis infima basi connatis.

*Central Karasberg.* Summit of Scharfenstein, 8556.

Anthephora pubescens, Nees. *Eastern Karasberg.* Narudas Süd, 8535.

Tricholaena rosea, Nees. *Eastern Karasberg.* Sandstone cliffs, Narudas Süd, 8513.

Tricholaena arenaria, Nees. *Eastern Karasberg.* Among stones, lower foothills, Narudas Süd, 8167.

Trichopteryx flavida, Stapf. *Central and Eastern Karasberg.* Between Narudas Nord and Krai Kluft, 8491. In clefts in granite on foothills, Narudas Süd, 8490.

Aristida Adscensionis, Linn. *Great Karasberg.* 8493.

Aristida stipoides, Lam., var. meridionalis, Stapf. *Central and Eastern Karasberg.* Summit of Scharfenstein, 8494. Stony flat on right bank of Keiap R., Narudas Süd, 8307. Upper slopes, Narudas Süd, 8182.

Aristida ciliata, Desf. *Central Karasberg.* In coarse sand on bank of dry water-course, Krai Kluft, 8496.

Aristida namaquensis, Trin. *Western and Central Karasberg.* Dry sandy river-bed on high plateau between Krai Kluft and Wasserfall, 8497. Common in sandy ravines, Wasserfall, 8078.

Aristida obtusa, Del. *Central and Eastern Karasberg.* On sandy plains, Krai Kluft, 8494. Among granite blocks in ravine, Narudas Süd, 8498. Sandy plains north-east of Narudas Süd, 8146.

Aristida uniplumis, Lichtenst. *Western and Central Karasberg.* Rough quartz-strewn slopes 200 ft. above Wasserfall Alt, and in dry sandy water-course on slopes between Wasserfall Alt and Dassiefontein, 7755. Broad dry sandy water-course between Krai Kluft and Wasserfall, 8500. Sandy slopes near Krai Kluft, 8499.

Sporobolus ioclados, Nees. *Western Karasberg.* Sandy bed of water-course above Wasserfall Alt Ravine, 8478.

Sporobolus Sladenianus, Bol. f. *Central and Eastern Karasberg.* High plateau between Narudas Süd and Krai Kluft, 8103.

Diplachne fusca, Beauv. *Central and Eastern Karasberg.* In shallow drying pools between Narudas Nord and Krai Kluft (camel path), 8489. Rooted among stones in water in Keiap R., Narudas Süd, 8488.

Eragrostis curvula, Nees. *Central Karasberg.* Summit Scharfenstein, 8476.

Eragrostis Lehmanniana, Nees. *Eastern Karasberg.* Among granite blocks in ravine, Narudas Süd, 8477.

Eragrostis chloromelas, Steud. *Eastern Karasberg.* Sand in river-bed, Narudas Süd, 8336.

Eragrostis porosa, Nees. *Central Karasberg.* Among stones on bank of dry stream channel on plains south-west of Krai Kluft, 8479.

Eragrostis bicolor, Nees. *Great Karasberg.* 8480.

Eragrostis Atherstonei, Stapf. *Eastern Karasberg.* Among stones on river-bank, Narudas Süd, 8305.

Eragrostis heteromera, Stapf. *Western Karasberg.* Moist patch of gravel in lateral ravine 100 ft. above Wasserfall Alt, 8481.

Eragrostis denudata, Hack. *Central and Eastern Karasberg.* Sandstone plateau on summit of Long Hill, east of Krai Kluft, 8482. Stony flats south of Keiap R. at Narudas Süd, 8317.

Eragrostis karasbergensis, Bol. f., n.sp., *E. majori* proxime accedit, sed perennis, multi-nodia, copiose ramosa, glumis marginibus integerrimis.

Herba perennis; culmi geniculato-adscendentes vel suberecti, graciles, teretes, rigidi, copiose ramosi, glabri, laeves, multi-nodii, plus minusve exserti, 0·37—0·40 met. alti; foliorum vaginae laxae, nervoso-striatae, saepissime marcescentes, direptae, demum a culmis delapsentes, plus minusve glandulosae, minute ciliatae, inferiores paucis longis pilis, superiores saepissime magis dense barbatae, aliter glabrae; ligula e linea capillorum brevium composita; laminae lineares vel lineari-lanceolatae, tenuissime setaceo-attenuatae, planae, valde robuste nervoso-striatae, supra scaberulae, infra laeves, saepissime marginibus glandulosis, subglaucae, 4—14 cm. longae, 0·2—0·45 cm. latae; panicula ovata vel oblonga, sublaxa, axi subtereti, subflexuoso, superne scabrido, inferne laevi, 7—11·5 cm. longa, 3·5—7·5 cm. lata, ramis plerumque solitariis, subdistantibus, erecto-patentibus, vel superiores plus minusve porrectis, firmis, subflexuosis, inferne laevibus, superne scabridis, interdum axillis incrassatis, pilis paucis donatis, infimis ad 6 cm. longis, simplicibus ad 0·3—1·2 cm. supra basin; pedicelli parum infra apicem viscoso-annulati, scabridi, angulares, lateralibus 0·1—0·4 cm. longis; spiculae oblongae vel ovales, 5—18-fl., 0·3—0·95 cm. longae, 0·25—0·32 cm. latae; glumae subaequales, ovatae, obtusae, dimidio superiore carinis scaberulis, inferior 1-, superior 3-nervia, 0·15 cm. longae; valvae lateraliter visae ovatae vel oblongae, obtusae, nervis lateralibus prominentibus, 0·17 cm. longae; paleae valvis vix breviores, leviter apice emarginatae, carinis minute scaberulis vel ciliolatis; antherae lineares, 0·1 cm. longae.

*Central and Eastern Karasberg.* River-bed between Krai Kluft and Narudas Süd, 8484. Narudas Süd, 8485.

Very closely allied to *E. major*, Host., but differs in being perennial, with the culms many-noded and copiously branched, and the margins of the glumes quite entire.

Eragrostis obtusa, Munro. *Central and Eastern Karasberg.* Sand-bank in partial shadow, Keiap R., 8483.

Eragrostis brizantha, Nees. *Western, Central and Eastern Karasberg.* Water-course above Wasserfall Alt Ravine, 8487. Clefts in sandstone upper Krai Kluft Ravine, 8486. Rooted among stones in water in Keiap R., Narudas Süd, 8488.

Triraphis ramosissima, Hack. *Western Karasberg.* Lateral ravine about 100 ft. above Wasserfall Alt, 8492.

Enneapogon scaber, Lehm. *Eastern Karasberg.* Narudas Süd, 8514.

Schmidtia bulbosa, Stapf. *Western and Central Karasberg.* Broad dry sandy water-course between Krai Kluft and Wasserfall Alt plateau, 8515.

Ehrharta longifolia, Schrad., var. ligulis membranaceis, var. nov., Bol. f. *Western Karasberg.* Sandy river-bed above Wasserfall Alt Ravine, 8475.

Fingerhuthia africana, Lehm. *Eastern Karasberg.* Lower foothills, Narudas Süd, 8173.

## Filices

Ophioglossum vulgatum, Linn. *Central Karasberg.* Middle slopes of hill N. of ravine, Krai Kluft 8194.

Nothochlaena Rawsoni, Pappe. *Central Karasberg.* Rocky ledge, Krai Kluft Ravine, 8290.

Nothochlaena Eckloniana, Kze. *Central Karasberg.* Common on rocky ledges, Krai Kluft Ravine, 8278.

Gymnogramme cordata, Schl. *Eastern Karasberg.* Granite foothills, Narudas Süd, 8557.

Pellaea calomelanos, Link. *Central Karasberg.* Krai Kluft Ravine, 8277.

Cheilanthes multifida, Sw. *Central Karasberg.* Scharfenstein, 8558.

Cheilanthes hirta, Sw. *Central Karasberg.* Scharfenstein, 8559.

Cheilanthes parviloba, Sw. *Eastern Karasberg.* Lower eastern slopes, under granite boulders, Narudas Süd, 8114.

## Burseraceae

Commiphora abyssinica, Engl., var. simplicifolia. *Central Karasberg.* Upper slopes and plains, Krai Kluft, 8272.

### *Plants collected by the Percy Sladen Memorial Expedition* 1912–1913, *outside the Great Karasberg*

| | |
|---|---|
| Antizoma capensis (Linn. f.), Diels var. pulverulenta, Haw. | Aus, among rocks, 8061. |
| Capparis punctata, Burch. | Aus, 8060. |
| Boscia foetida, Schinz. | Kuibis Ravine, 8008. |
| Hermannia gariepina, E. & Z. | Aus, rocky places, 8037. |
| Hermannia althaeifolia, Linn. | Aus, 8053. |
| Tribulus Zeyheri, Sond. | Aus, 8214. |
| Tribulus Zeyheri, Sond. | Aus, sandy ground, 8039. |
| Zygophyllum Dregeanum, Sond. | Aus, quartzite hill, 8033. |
| Zygophyllum longicapsulare, Schinz. | Aus, quartzite hill, 8034. |
| Zygophyllum microcarpum, Licht. | Kuibis, sandy places, 8011. |
| Sisyndite spartea, E. Mey. | Railway embankment between Klein Karasberg and Holoog, 7867. |
| Sarcocaulon Patersoni, DC. | Kuibis, sandy places, 8015. |
| Pappea capensis, E. & Z. | Aus, common on hill-sides among granite boulders, 8054, 8048. |
| Melianthus comosus, Vahl. | Aus, common in river-bed, 8052. |
| Psoralea obtusifolia, DC. | Kuibis, sandy hollow in quartzite plain, 8026, 8012. |
| Lebeckia obovata, Schinz. | Aus, east of railway station, 8036. |
| Acacia hebeclada, DC. | Kuibis Ravine, 8009. |
| Acacia detinens, Burch. | Top of ravine leading down to Kuibis water-station, 8001. |
| Cotyledon orbiculata, Linn. | Aus 8063, 8064. |
| Citrullus ecirrhosus, Cogn. | Aus, rocks, 8046. |
| Mesembrianthemum parvifolium, Haw. | Aus, 8058. |
| Mesembrianthemum namibense, Marl. | Aus, 8057. |
| Mesembrianthemum calcareum, Marl. | Kuibis, 8696. |
| Mesembrianthemum caducum, Ait. | Between Nakeis and Klein Karasberg, 8215. |

Pteronia acuta, Muschler. Kuibis, 8020.

Nidorella punctulata, DC. Kuibis Ravine, 8004.

Geigeria Pearsonii, L. Bolus, n. sp., *G. vigintisquameae,* O. Hoffm. proxime accedit, sed foliis anguste linearibus integris, capitulis terminalibus submajoribus, aristis quam pappi squamae ipsae brevioribus, differt.

Suffrutex erectus rigidus ramosus; rami adscendentes vel divaricati, foliosi, cum foliis viscoso-hispiduli, demum cortice albido papyraceo vestiti, ad 15 cm. longi, 0·5 cm. diam., internodiis 0·2—0·3 cm. longis; folia adscendentia vel patentia, sessilia, breviter decurrentia, axillis lanatis, supra basin articulata, anguste linearia, basin versus vix angustata, ad apicem sensim attenuata, pungenti-mucronata, nervo medio conspicuo, subtus prominente, 2·5—4 cm. longa, 0·2—0·25 cm. lata; capitula sessilia apicibus ramorum ramulorumque, circa 1·4 cm. longa, involucro, parte globoso, 0·8—1 cm. diam., supra medium constricto, squamis multiseriatis, exterioribus foliaceis, interioribus subhyalinis rigidis attenuato-mucronatis ciliatis, apice recurvis, intimis incurvis, acuminatis; receptaculum leviter convexum vel planum, dense setosum, setis 0·3—0·5 cm. longis; radii flosculi 8—10, corolla 1·7 cm., disci 1·2 cm. longa; achaenia longe densissimeque pilosa, 0·15—0·2 cm. longa; pappi squamae exteriores 10, exaristatae, 0·1—0·15 cm. longae, interiores 10, aristatae, longiores usque ad duplum. Kuibis, 8021.

Very closely allied to *G. vigintisquamea*, O. Hoffm., but the leaves are narrow, linear and entire, the heads terminal and rather larger, and the awns on the inner pappus scales are shorter than the scales themselves. Plate XIV, A.

Eremothamnus Marlothianus, O. Hoffm. Shallow ravines, Lüderitzbucht, 8047.

Berkheyopsis Echinus, O. Hoffm. Railway embankment between Nakies and Klein Karas, 7934.

Berkheya sp.—material insufficient. Kuibis Ravine, 8007.

Euclea Pseudebenus, E. Mey. Kuibis Ravine, 8005.

Raphionacme sp.—fruit only. Sandstone plateau, among sandstone blocks, 8472.

Microloma longituba, Schinz. Between Gründoorn and Nakeis, in stony plains, 8463.

Asclepias filiformis, Benth. and Hook. f. River-bed above quartzite hill, 8035. Near bottom of valley W. of Aus, 8056.

Asclepias Burchellii, Schltr. Bottom of Kuibis Ravine, 8002.

Codon Royeni, Linn. Quartzite hill, Aus, 8030.

Convolvulus ulosepalus, Hall. f. River-bed between Klein Karas and Holoog, 7961.

Aptosimum glandulosum, Webber and Schinz? Railway embankment between Klein Karas and Holoog, 7948.

Aptosimum viscosum, Benth. Common on dry stony slopes, Aus, 8049.

Anticharis scoparia, Hiern. Quartzite plains, Kuibis, 8028.

Sutera Maxii, Hiern. Kuibis Ravine, among rocks, 8003, 8017.

Cataphractes Alexandri, Spring. Sandy hollows on quartzite plain, Kuibis, 8025.

Monechma arenicola, C. B. Cl. Quartzite plain, Kuibis, 8027.

Dicliptera hereroensis, Schinz. ? Kuibis, 8019.

Selago albida, Choisy. Sandy hollows, Kuibis, 8013.

Acrotome pallescens, Benth. Among rocks N. of town, Aus, 8040.

Calicorema capitata, Hook. f. Quartzite hill, Aus, 8032.

Chenolea diffusa, Thunb. Lüderitzbucht, water edge, 8044.

Microtea Burchellii, N. E. Br. Dry rocks, Aus, 8041.

Loranthus sp.—material insufficient. Kuibis, 8018.

Viscum pauciflorum, Thunb. Kuibis Ravine, 8006.

Euphorbia rudis, N. E. Br. Quartzite plain, Kuibis, 8014.

Euphorbia lignosa, Marl. Quartzite hill, Aus, 8031.

Forskohlea candida, Willd. Railway embankment between Klein Karas and Holoog, 8546.

Asparagus capensis, Linn., var. desertorum, nov. var., Lüderitzbucht, just above high water mark, 8045.

Pseudogaltonia Pechuelii, Kunth. Sandy banks 5 miles E. of Gründoorn 8066.

Urginea sp. (material incomplete). Aus, in a bush in dry stony bank, 8051.

Spartina stricta, Roth—probably. Sand, Lüderitzbucht, washed at high tide, 8043. Not in flower.

# THREE FUNGI COLLECTED ON THE PERCY SLADEN MEMORIAL EXPEDITIONS OF 1910–11 AND 1912–13.

By I. B. POLE EVANS, M.A., B.Sc., F.L.S.

The following three fungi were kindly sent to me for determination by Prof. H. H. W. Pearson from his collection of plants made during the Percy Sladen Memorial Expeditions of 1910—11 and 1912—13.

*Uredo Augeae* Pole Evans nov. spec.

Soris uredosporiferis amphigenis, sine maculis, in greges orbiculares concentrice dispositis, rotundatis, 1—2 mm. diam., epiderme vesiculosa diu velatis, postea nudis, epidermide fissa cinctis, obscure castaneis; uredosporis subglobosis, ellipsoideis vel ovatis, aculeatis, brunneis, 21—25 × 27—31 $\mu$, episporio ca. $1\frac{1}{2}$—$2\frac{1}{2}\,\mu$ crasso.

On living leaves of *Augea capensis*, Lüderitzbucht. H. H. W. Pearson, No. 8029, November 1912 (Pole Evans, No. 8406). The same fungus was also found on material of *Augea capensis* preserved in formalin and collected by J. Burtt-Davy at Laingsburg in Prince Albert Division of the Cape as far back as November 7th, 1910.

*Ustilago Sladenii* Pole Evans nov. spec.

Soris olivaceo-atris, pulverulentis in rachidibus floribusque, eos omnino destruentibus; sporis globosis vel subglobosis 5–6 $\mu$ diam.; glabris, dilute olivaceis.

In the flowers and branches of the inflorescence of a grass (probably *Ehrharta* sp.) Garies 1910—11.

H. H. W. Pearson, No. 6728 (Pole Evans, No. 8409).

*Uromyces inaequialtus* Lasch.

On Silene spec., Namaroup., 12. ix. 1911. H. H. W. Pearson, No. 6657 (Pole Evans, No. 8407).

THE BOTANICAL LABORATORIES OF THE
UNION OF SOUTH AFRICA, PRETORIA.

# KEY TO THE FLORA OF THE CAPE PENINSULA

By F. and L. BOLUS

(*Continued from page* 35)

## RANUNCULACEAE

| | |
|---|---|
| Twining. | Clematis, Linn. |
| Not twining. | |
|  Sepals not green; carpels long-tailed. | Anemone, Hall. |
|  Sepals green; carpels not tailed. | |
|   Petals numerous, greenish; carpels juicy. | Knowltonia, Salisb. |
|   Petals 5—10, white or yellow; carpels dry. | Ranunculus, Hall. |

### Clematis

| | |
|---|---|
| | *brachiata*, Thunb. |

### Anemone

| | |
|---|---|
| | *capensis*, Linn. |

### Knowltonia

| | |
|---|---|
| Leaves glabrous or sparingly hairy. | |
|  Ovary as long as style. | *vesicatoria*, Sims. |
|  Ovary shorter than style. | |
|   Ovary glabrous. | *rigida*, Sims. |
|   Ovary setose. | *gracilis*, DC. |
| Leaves densely hairy. | *hirsuta*, DC. |

### Ranunculus

| | |
|---|---|
| Submerged; leaves multi-partite; petals white. | *rigidus*, Godr. |
| Terrestrial, often in swamps; petals yellow. | |
|  Pubescent. | |
|   Tall, branched; fls. panicled. | *pubescens*, Thunb. |
|   Dwarf, subsimple; fls. solitary, opposite the leaves. | *capensis*, Thunb. |
|  Glabrous. | |
|   Achenes smooth. | *sceleratus*, Linn. |
|   Achenes muricate. | *muricatus*, Linn. |

## MENISPERMACEAE

Cissampelos, Linn.

### Cissampelos

*capensis*, Thunb.

## NYMPHAEACEAE

Nymphaea, Linn.

### Nymphaea

*stellata*, Willd.

## PAPAVERACEAE

| | |
|---|---|
| Fruit many-seeded, dehiscent. | Corydalis, DC. |
| Fruit 1-seeded, indehiscent. | Fumaria, Linn. |

### Corydalis

| | |
|---|---|
| Capsule lanceolate ; petals equal. | *cracca*, Schlecht. |
| Capsule globose ; petals unequal. | *vesicaria*, Pers. |

### Fumaria

| | |
|---|---|
| Fruit flattened, with a marginal wing. | *Mundtii*, Spreng. |
| Fruit subglobose, without a marginal wing. | *officinalis*, Linn.<br>(= *muralis*, Sond.) |

## CRUCIFERAE

| | |
|---|---|
| Fruit a siliqua. | |
| Valves of the siliqua flat. | |
|  Calyx 2-spurred at base. | Chamira, Thunb. |
|  Calyx not 2-spurred at base. | |
|   Fully developed leaves 3-foliolate. | Cardamine, Linn. |
|   Fully developed leaves not 3-foliolate. | Heliophila, Linn. |
| Valves of the siliqua keeled or round-backed. | |
|  Siliqua indehiscent. | |
|   Leaves narrow-linear, entire. | Carponema, Sond. |
|   Leaves obovate-oblong or obovate, not entire. | |
|    Siliqua 2-jointed. | Rapistrum, Medik. |
|    Siliqua > 2-jointed. | Raphanus, Linn. |
|  Siliqua dehiscent. | |
|   Siliqua with a beak nearly half its length. | Brassica, Koch. |
|   Siliqua with a beak much less than half its length. | |
|    Seeds 2-seriate. | |
|     Leaves mostly cauline. | Nasturtium, R. Br. |
|     Leaves mostly radical. | Diplotaxis, DC. |
|    Seeds 1-seriate. | |
|     Siliqua erect, adpressed, acuminate. | Sisymbrium, All. |
|     Siliqua ascending, obtuse. | Barbarea, R. Br. |

Fruit a silicula.
  Silicula dehiscent.
    Valves boat-shaped, partition narrow. **Lepidium**, Linn.
    Valves not boat-shaped, partition broad.
      Silicula < 2 ls. long, 2-seeded. **Alyssum**, Linn.
      Silicula 2 ls. or more long, 2 or more seeded.
        Silicula oval or orbicular. **Heliophila**, Linn.
        Silicula triangular-cuneate. **Capsella**, Vent.
  Silicula indehiscent.
    Leaves not sagittate at base.
      Petals scarcely as long as sepals. **Senebiera**, DC.
      Petals much longer than the sepals. **Brachycarpaea**, DC.
    Leaves sagittate at base. **Neslia**, Desv.

### Chamira

*cornuta*, Thunb.

### Cardamine

*africana*, Linn.

### Heliophila

Stems more or less woody (perennials).
  Leaves lobed. *abrotanifolia*, Banks.
  Leaves entire.
    Siliqua stipitate; leaves up to 4 ls. wide. *callosa*, DC.
    Siliqua sessile; leaves up to 2 ls. wide.
      Inflorescence long-pedunculate. *subulata*, Burch.
      Inflorescence not long-pedunculate.
        Racemes dense, few-fld.; petals mauve-pink. *scoparia*, Burch.
        Racemes lax, many-fld.; petals blue.
          Siliqua ½ l. wide, tipped with a filiform style. *elata*, Sond.
          Siliqua 1—1½ l. wide, tipped with a subulate style. *linearifolia*, Burch.
Stems more or less herbaceous (annuals).
  Margins of the siliqua crenate or undulate (moniliform).
    Petals < 2 ls. long. *pusilla*, Linn. f.
    Petals > 2 ls. long.
      All the stamens toothed. *dentifera*, Sond.
      Some or all the stamens toothless.
        Siliqua tipped with a knob-like style. *dissecta*, Thunb.
        Siliquas not tipped with a knob-like style.
          Plant more or less hairy below; stamens toothless. *coronopifolia*, Linn.

- Plant glabrous; lateral stamens toothed.
  - Leaves pinnatipartite, lobes linear; beadings of the siliqua oval. *sonchifolia*, DC.
  - Leaves usually 3-fid, lobes subfiliform; beadings of the siliqua orbicular. *trifida*, Thunb.
- Margins of the siliqua straight or very nearly so.
  - Siliquas oblong or suborbicular.
    - Siliqua 4—8-seeded. *diffusa*, DC.
    - Siliqua 1—4-seeded. *Peltaria*, DC.
  - Siliquas linear.
    - Siliqua > 1 l. broad. *scabrida*, Schltr.
    - Siliquas 1 l. or less broad.
      - Leaves entire or variously lobed, the segments never filiform; plants hairy. *pilosa*, Lam.
      - Leaves partite, the segments filiform.
        - Leaf-segments usually 3.
          - Siliqua deflexed; petals whitish; stamens toothless. *trifurca*, Burch.; var. *parviflora*, Sond.
          - Siliqua erect; petals yellowish; stamens? *tabularis*, Wolley-Dod.
        - Leaf-segments > 3.
          - Plant hairy. *foeniculacea*, R. Br.
          - Plants glabrous.
            - Siliqua tipped with a filiform style, 1—1½ ls. long, valves subtorulose; petals mauve-pink. *tenuifolia*, Sond.
            - Siliqua tipped with a short obtuse style, ½ l. long, valves straight; petals bright blue. *refracta*, Sond.

### Carponema

*filiforme*, Sond.

### Rapistrum

*rugosum*, DC.

### Raphanus

*Raphanistrum*, Linn.

### Brassica

Siliqua about ½ in. long. *Sinapioides*, Roth.

Siliqua about 1 in. long. *Sinapistrum*, Boiss.

### Nasturtium

*officinale*, R. Br.

### Diplotaxis

*muralis*, DC.

### Sisymbrium

*officinale*, Linn.

### Barbarea

*praecox*, R. Br.

### Lepidium

*ruderale*, Linn.

### Alyssum

*maritimum*, Lam.

### Capsella

*Bursa-pastoris*, Moench.

### Senebiera

Silicula slightly wrinkled, about 1 l. broad. — *didyma*, Pers.
Silicula strongly wrinkled, about 2 ls. broad. — *Coronopus*, Poir.

### Brachycarpaea

*laxa*, Sond.

### Neslia

*paniculata*, Desf.

## RESEDACEAE

Reseda, Linn.

### Reseda

Leaves pinnatifid; petals white. — *alba*, Linn.
Leaves not pinnatifid; petals yellowish. — *odorata*, Linn.

## VIOLARIEAE

Viola, Linn.

### Viola

Perennial, suffruticose. — *decumbens*, Linn. f.
Annual. — *tricolor*, Linn. (= *arvensis*, Murray).

## BIXACEAE

Leaves rigid and glossy; fls. hermaphrodite. — Scolopia, Schreb.
Leaves not rigid and glossy; fls. dioecious. — Kiggelaria, Linn.

### Scolopia

*Mundtii*, Warb.

### Kiggelaria

*africana*, Linn.

## POLYGALEAE

Sepals very unequal, the lateral large and petaloid.
  Fruit a capsule; branches not spinescent. — Polygala, Tourn.
  Fruit a berry; branches spinescent. — Mundtia, Kunth.
Sepals nearly equal, all dry and membranous. — Muraltia, Neck.

### Polygala

- Carina with a much divided usually showy crest.
  - Branches often nearly leafless; leaves mostly minute.
    - Flowers $<$ 3 ls. long. *macra*, DC.
    - Flowers $>$ 3 ls. long. *refracta*, DC.
  - Branches leafy; leaves well-developed.
    - Leaves not keeled, the margins often recurved, mostly 1 l. or more broad.
      - Flowers $<$ 4 ls. long. *Dodii*, Schltr.
      - Flowers $>$ 6 ls. long.
        - Shrub; racemes short, usually $<$ 6-fld. *myrtifolia*, Linn.
        - Herbs or subshrubs; racemes elongated, $>$ 6-fld.
          - Lateral petals with one long and one short lobe. *bracteolata*, Linn.
          - Lateral petals not 2-lobed. *virgata*, Thunb.
    - Leaves ± keeled, $<$ 1 l. broad.
      - Peduncles erect or erect-spreading, terminal.
        - Lateral petals usually bifid; capsule not toothed at the apex. *ericifolia*, DC.
        - Lateral petals not bifid; capsule 2-toothed at the apex. *Garcini*, DC.
      - Peduncles horizontal or deflexed, lateral. *refracta*, DC.

### Mundtia

*spinosa*, DC.

### Muraltia

- Flowers sessile.
  - Ovary and capsule without horns. *ciliaris*, DC.
  - Ovary and capsule horned.
    - Upper leaves distinctly broader than lower leaves.
      - Lateral petals hatchet-shaped; pubescence of long white spreading hairs. *phylicoides*, Thunb.
      - Lateral petals not hatchet-shaped; pubescence appressed.
        - Branches slender trailing prostrate. *diffusa*, Burch.
        - Branches robust, more or less ascending.
          - Upper broader leaves densely crowded at ends of branches. *alopecuroides*, DC.
          - Upper broader leaves not densely crowded at ends of branches. *thymifolia*, Thunb.
    - Upper leaves not distinctly broader than lower leaves.
      - Primary leaves oval, ovate or ovate-lanceolate.
        - Leaf margins revolute; mid-rib hairy beneath; sepals longer than lateral petals. *serpylloides*, DC.
        - Leaf margins not revolute; adult leaves glabrous; sepals shorter than lateral petals.

Branches slender trailing prostrate. *diffusa*, Burch.
Branches robust ascending. *thymifolia*, Thunb.
Primary leaves lanceolate, subulate, linear or clavate.
Lateral petals reaching or very nearly reaching to tip of keel-crest.
Leaves usually muticous, primary often much reduced; horns not longer than capsule; branches finally subspinescent. *macropetala*, Harv.
Leaves pungent or mucronate, primary usually well-developed; horns much longer than capsules; branches not subspinescent.
Leaves dorsally keeled, pungent; fls. > 4 ls. long, conspicuous. *Heisteria*, DC.
Leaves dorsally rounded, long-mucronate; fls. < 3 ls. long, inconspicuous. *longicuspis*, Turcz.
Lateral petals shorter than, equalling or slightly longer than keel.
Leaves rigid, pungent; fls. > 3 ls. long. *brachypetala*, Wolley-Dod.
Leaves scarcely rigid, mucronate; fls. < 3 ls. long.
Branches slender trailing prostrate. *diffusa*, Burch.
Branches ± robust, ascending.
Inner sepals acuminate, as long as the petals or longer.
Leaves ± erect, the secondary usually not developed. *filiformis*, DC.
Leaves spreading, the secondary usually well-developed. *conferta*, DC.
Inner sepals acute or obtuse, shorter than petals.
Secondary leaves usually not well-developed.
Petals shorter than keel. *filiformis*, var.
Petals as long as keel. *stipulacea*, DC. var.
Secondary leaves well-developed.
Leaf-tufts distant, leaves broader above the middle, obtuse. *dumosa*, DC.
Leaf-tufts ± crowded, leaves gradually tapering to the apex.
Branches short, twiggy; sepals conspicuous. *demissa*, Wolley-Dod.
Branches virgate; sepals ± hidden by the leaves.
Leaves recurved. *recurva*, Wolley-Dod.
Leaves not recurved (the lower often reflexed).
Petals acute, subdeltoid at the apex. *satureoides*, Burch.
Petals obtuse. *mixta*, Linn.
Flowers pedicellate.
Leaves acute; pedicels longer than the flower. *pauciflora*, DC.
Leaves obtuse; pedicels shorter than the flower. *striata*, DC.

## FRANKENIACEAE

FRANKENIA, Linn.

### FRANKENIA

Leaves linear or oblong, with strongly revolute margins; fls. 4—5 ls. long. *laevis*, Linn.
Leaves oval or obovate, with slightly revolute margins; fls. usually < 4 ls. long. *pulverulenta*, Linn.

## CARYOPHYLLACEAE

Calyx tubular, 5-toothed.
Calyx bracteolate at base; styles 2. DIANTHUS, Linn.
Calyx ebracteolate at base; styles 3. SILENE, Linn.
Calyx 4—5 parted.
Leaves without stipules.
Styles 3. STELLARIA, Linn.
Styles 4—5. CERASTIUM, Linn.
Leaves with membranous stipules.
Styles 5. SPERGULA, Linn.
Styles < 5.
Sepals sharply keeled, mucronate; style 3-fid. POLYCARPON, Linn.
Sepals not keeled; styles 3. SPERGULARIA, J. et C. Presl.

### DIANTHUS

*incurvus*, Thunb.

### SILENE

Inflorescence cymose; capsule 1-locular at base.
Leaves undulate; petals white or pink. *undulata*, Ait.
Leaves not undulate; petals deep red. *ornata*, Ait.
Inflorescence as if racemose or spicate; capsule 3-locular at base.
Petals undivided or emarginate. *gallica*, Linn.
Petals bifid.
Lowest leaves suborbicular or obovate, densely hairy, fleshy. *crassifolia*, Linn.
Lowest leaves linear, lanceolate-linear or spathulate, sparingly pubescent, not fleshy.
Annual; calyx about 6 ls. long. *clandestina*, Jacq.
Perennial; calyx about 9 ls. long. *Burchellii*, Otth.

### STELLARIA

*media*, Vill.

### CERASTIUM

Perennial; petals longer than calyx. *Dregeanum*, Fenzl.

Annual; petals not longer than calyx.

Sepals nude at the apex; petals shorter than calyx. *capense*, Sond.

Sepals bearded at the apex; petals as long as calyx. *glomeratum*, Thuill.

### Spergula

*arvensis*, Linn.

### Polycarpon

*tetraphyllum*, Linn. f.

### Spergularia

Leaves flat on both sides. *rubra*, Pers.

Leaves convex on both sides. *media*, Pers.

## MALVACEAE

Carpels separable.

Styles filiform, stigmatose along the upper side.

Bracteoles 3—6, connate at base; axis of fruit produced beyond the carpels. Lavatera, Linn.

Bracteoles 3, quite free; axis of fruit not produced. Malva, Linn.

Styles filiform, stigmas capitellate. Malvastrum, A. Gray.

Carpels united to form a capsule. Hibiscus, Linn.

### Lavatera

*arborea*, Linn.

### Malva

Carpels transversely ribbed; petals scarcely longer than calyx. *parviflora*, Linn.

Carpels almost smooth; petals distinctly longer than calyx. *verticillata*, Linn.

### Malvastrum

Erect shrub, glandular-pubescent; peduncles much longer than petioles. *calycinum*, Gray and Harv.

Decumbent, subherbaceous, not glandular; peduncles shorter than or very little longer than petioles. *albens*, Harv.

### Hibiscus

Flowers racemose; plant prickly. *diversifolius*, Jacq.

Flowers solitary; plant not prickly.

Perennial; dwarf; leaves toothed or subentire; calyx not inflated. *aethiopicus*, Linn.

Annual; leaves 3—5-lobed or partite; calyx inflated. *Trionum*, Linn.

## STERCULIACEAE

Hermannia, Linn.

### Hermannia

Leaves toothed, crenate, or entire.

Stipules 2—3-partite. *verticillata*, K. Schum.

Stipules not 2—3-partite.

Calyx nearly as long as the corolla, the tips of the segments converging and more or less closely embracing the corolla.

Leaves lanceolate or elliptic-lanceolate, acute; calyx-tube much inflated. *hyssopifolia*, Linn.

Leaves broadly oblong or cuneate or obovate-cuneate.

Calyx-lobes shorter than the tube.

Flowers in subcapitate clusters; leaves prominently veined below. *salvifolia*, Linn.

Flowers solitary or 2-nate, leaves not prominently veined below. *ternifolia*, Presl.

Calyx-lobes equalling or longer than the tube. *rudis*, N. E. Br.

Calyx about half as long as the corolla, the tips of the segments more or less spreading.

Leaves entire, velvety pubescent. *lavandulifolia*, Linn.

Leaves toothed, not velvety pubescent.

Stipules linear, not widened at base. *scoparia*, Harv.

Stipules not linear, widened at base.

Stipules 6—9 ls. long; leaves 1—2 in. long. *althaeifolia*, Linn.

Stipules < 6 ls. long; leaves usually < 1 in. long.

Flowers < 3 ls. long. *alnifolia*, Linn.

Flowers > 4 ls. long.

Leaves closely pubescent, paler on the lower surface. *cuneifolia*, Jacq.

Leaves glabrescent, not paler on the lower surface.

Calyx loosely pubescent with spreading hairs; claw of petal ciliate. *decumbens*, Willd.

Calyx glabrescent; claw of petal glabrous. *procumbens*, Cav.

Leaves pinnatifid or pinnatifid and subentire on the same plant.

Capsule inflated, broader than long. *vesicaria*, Cav.

Capsule not inflated, longer than broad.

Stipules 2—3-partite; leaves < 2 ls. broad.

Bracts linear, separate. *verticillata*, K. Schum.

Bracts semi-ovate, connate. *diffusa*, K. Schum.

Stipules not 2—3-partite; leaves > 2 ls. broad.

Calyx-segments lanceolate, equalling or longer than the tube. *scabra*, L. Bolus[1].

Calyx-segments subdeltoid, shorter than the tube. *procumbens*, Cav

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[1] Hermannia scabra, L. Bolus, nov. comb.

# NOVITATES AFRICANAE

Diosma Bolusii, Glover (*Rutaceae-Diosmeae*). *D. cupressinae,* affinis sed foliis carina glandulosis, petalis minoribus, omnibus apicibus adhaerentibus simulque deciduis, lobis disci glandula sessili munitis, ovario pubescente, distinguitur.

Fruticulus intertexte ramosus, circa 30 cm. altus; rami abbreviati, crebre bifurcati, puberuli; folia erecto-adpressa vel patentia, imbricata, opposita, decussata, ovato-oblonga, triquetra, integra, acuta vel obtusa, ciliata, supra glaberrima, concava, infra pubescentia carinata, carinis parce glandulosis, ad 0·3 cm. longa, 0·1 cm. lata; flores saepissime solitarii, terminales vel axillares, inconspicui; bracteae foliaceae; sepala late ovata vel subrotunda, acuta vel obtusa, ciliata, utrinque pubescentia, infra carinata, circa 0·2 cm. longa, 0·15 cm. lata; petala inconspicua, apicibus adhaerentia, cito decidua, subacuta, unguibus brevibus, 0·5 cm. longis, laminis ovatis, basi subcordatis, ciliatis, glabris, 0·15 cm. longis; discus quinquelobatus, lobis sessili glandula munitis; stamina disco adnata, filamentis subulatis, 0·1 cm. longis, antheris glandula sessili munitis; staminodia 0; stylus subulatus; capsella 5-cocca, cornubus obtusis, ad 0·6 cm. longa.

Cape Province: South-Western Region; on rocky slopes of the Zwartberg Mts. in the Zwartberg Pass, Prince Albert Div., *H. Bolus,* 11,460.

Nearest to *D. cupressina,* Linn. but to be distinguished from that species by having a few glands on the keels of the leaves, petals cohering at the apex and early deciduous, the lobes of the disc furnished with a sessile gland and the ovary pubescent. Plate XV, C.

Diosma Guthriei, Glover (*Rutaceae-Diosmeae*). *D. succulentae* affinis sed sepalis longioribus, obtusioribusque, petalis glabris, minoribus, eciliatis, lobis disci glandula sessili munitis, cornubus capsellae longioribus, distinguitur.

Fruticulus ramosus, circa 30 cm. altus; rami dense foliosi, teretes, glabri, cicatricibus foliorum delapsorum conspicue notati, ramulis ultimis 1 cm. longis; folia patentia, opposita, decussata, sessilia, ovata, acuta, integra glabra, marginibus hyalinis, minute denticulatis, supra concava, infra carinata, glandulis paucis sparsis, 0·3—0·5 cm. longa, 0·2 cm. lata; flores solitares, terminales vel axillares, inconspicui; bracteae foliaceae; sepala ovata, acuta, integra, ciliata, glabra, carinata, infra glandulis paucis sparsis, 0·2 cm. longa, 0·13 cm. lata; petala late ovata, acuta, basi cuneata, integra, glabra, 0·3 cm. longa, 0·23 cm. lata, discus 5-lobatus, lobis sessili glandula apicali ornatis; stylus subulatus, 0·2 cm. longus; ovarium 5-loculare; capsella glaberrima, cornubus 0·5 cm. longis inclusis 1 cm. longa.

Cape Province: South-Western Region; on hillside, Bredasdorp, *F. Guthrie,* 3844; *H. Bolus,* 8476.

Nearest to *D. succulenta,* Berg. but to be distinguished by having longer and more obtuse sepals, smaller, glabrous and nonciliate petals, lobes of the disc furnished with a sessile gland, and longer horns to the capsule. Plate XV, D.

Acmadenia heterophylla, Glover (*Rutaceae-Diosmeae*). *A. laevigatae,* B. and W. affinis sed floribus terminalibus majoribus paucioribusque, petalis vix barbatis, staminodiis bene evolutis, distinguitur.

Fruticulus ramosissimus circa 30 cm. altus, ramis pubescentibus; folia erecto-patentia, apicem ramulorum versus imbricata, opposita vel sparsa, petiolata, ovato-oblonga, ovata vel subrotunda, acuta vel obtusa, supra concava, infra valde carinata, glandulis paucis sparsis, marginibus carinaque ciliata, integra, 0·3—0·5 cm. longa, 0·2—0·3 cm. lata; flores solitares vel apice ramulorum 2-nati vel 3-nati; bracteae medio apiceque foliaceae, aliter membranaceae, sepalis bracteis similibus sed margine membranaceo latiore, 0·4 cm. longa, 0·2 cm. lata; petala obovata, acuta vel obtusa, lamina glabra 0·5 cm. longa, 0·3 cm. lata, ungue ciliato, parce pubescente, 0·2 cm. longo; discus annularis; filamenta 0·15 cm. longa; staminodia 0·1 cm. longa; ovarium 5-loculare; stylus 0·1 cm. longus; stigma capitatum.

Cape Province: South-Western Region; Mossel Bay, *Brother Moran* (Bolus Herbarium 13,234). In fields near Mossel Bay, *Browne* (MacOwan, 3372).

Nearest to *A. laevigata,* B. and W. but may be distinguished from that species by its larger and fewer flowers at the end of the branchlets, by its almost beardless petals, and by its well-developed staminodes. Plate XV, B.

Acmadenia obtusata, Bartl. and Wendl. var. macropetala, Glover, nov. var. Petala obovata, acuta, circa 1 cm. longa, 0·4 cm. lata, lamina 0·7 cm. longa, ungue 0·3 cm. longo.

Cape Colony: South-Western Region; Hills around Albertinia, Riversdale Div., *J. Muir,* 930. Plate XV, A.

Argyrolobium Muirii, L. Bolus (*Leguminosae-Papilionatae-Genisteae*). *A. aciculari* accedit, sed ramis calyce leguminеque pilis patentibus vestitis, foliis sessilibus, foliolis latioribus, floribus solitariis majoribus, ceterisque differt.

Herba perennis, caule procumbente, ramos erectos tenues teretes, plus minusve dense vestitos pilis patentibus, ad 22 cm. longos, emittente; stipulae persistentes subulatae acuminatae, 0·2—0·3 cm. longae; folia erecta vel patentia, sessilia, foliolis spathulato-linearibus acutis, saepe mucronatis, complicatis, marginibus subinvolutis, supra glabris laevibusque, infra pilosis, praecipue nervo medio marginibusque, deinde glabrescentibus, internodios excedentibus, rarius eos aequantibus, intermedio lateralibus paullo longiore, 1—3 cm. longis, 0·2—0·3 cm. latis; flores solitarii in axillis foliorum superiorum; pedicelli 0·2—0·3 cm. longi, 3-bracteolati, bracteolis linearibus, 0·2 cm. longis; calyx extus pilosus, 1·1 cm. longus, segmentis acute acuminatis, ciliatis, anterioribus lanceolatis vel ovato-lanceolatis, 0·4 cm. longis, posterioribus lineari-lanceolatis, 0·8 cm. longis; vexillum 1·2 cm. longum, lamina ambitu orbiculare, basi utrinque lobo angusto, 0·1 cm. longo, ornata, extus apicem versus sericeo-villosa, ungue 0·15 cm. longo; alae oblongae, apice oblique truncatae, vexillo subaequilongae, lobo posteriore brevissimo; carina breviter rostrata, 1·1 cm. longa; ovarium lineare, supra basin dense sericeo-pilosum, pluri-ovulatum, 0·4 cm. longum; stylus glaber, stigmate obliquo; legumen lineare, in stylum persistentem desinens, basin versus angustatum, laxe pilosum, 3·5 cm. longum.

Cape Province: South-Western Region; Riversdale Div., Bovenplaats, nr. Albertinia, *J. Muir*, 1374.

Allied to *A. aciculare*, Dümmer, but differs in having the branches, calyx and legume clothed with spreading hairs, leaves sessile, leaflets broader, and flowers solitary and larger. Plate XVI, A.

Indigofera langebergensis, L. Bolus (*Leguminosae-Papilionatae-Galegeae* § *Pinnatae*). *I. frutescenti* proxime accedit sed nana, foliolis multo minoribus densioribusque, floribus minoribus.

Fruticulus, floribus exceptis, glaberrimus, ad 25 cm. altus; rami teretes vel subangulati, foliosi, internodiis 0·4—1·5 cm. longis; stipulae mox deciduae, patentes subulatae rigidae, 0·15 cm. longae; folia suberecta vel patentia, 2—5 cm. longa, petiolo 0·4—1·5 cm. longo, foliolis 2—6-, saepius 4-jugate, oppositis petiolulatis ovali-obovatis vel suborbicularibus, apice excisis vel mucronatis, coriaceis, 0·5—0·9 cm. longis, 0·4—0·7 cm. latis; racemi laxe multiflori, deinde foliis duplo longiores vel ultra, pedunculis petiolos sabaequantibus; bracteae minutae squamiformes; pedicelli 0·3 cm. longi; calyx hispidulus glabrescens, 0·3 cm. longus, segmentis obtusis vel acutis, dentiformibus, vix 0·1 cm. longis, sinu posteriore ceteris multo latiore; vexilli lamina oblonga, apice retusa, extus sericea brevissimis pilis, 1·3 cm. longa, ungue brevissimo; alae vexillo aequilongae, basi gibbosae; carina vexillo aequilonga, apice vero angustata erecta; ovarium stipitatum, anguste lineare, pluri-ovulatum, stipitate incluso, 0·8 cm. longum; legumen ignotum.

Cape Province: South-Western Region; Langebergen, Riversdale Div., Garcia's Pass, alt. 1500 ft., fl. Oct., *Bolus*, 11,267; *Galpin*, 5088. Corente River Farm, fl. Nov., *J. Muir*, 85. Mossel Bay Div., fl. April, *id.*, 1304.

Very closely allied to *I. frutescens* Linn. f. and perhaps only a stunted form of that species, but the leaflets besides being much smaller are broader in proportion to their length, being sometimes almost orbicular and are more closely set, and the flowers are smaller. Plate XVI, B.

Mesembrianthemum Tugwelliae, L. Bolus (*Ficoideae-Mesembrieae* § *Subquadrifolia*), forsitan *M. obtuso*, Haw. (minus cognito) accedit sed foliis valde compressis, glaucescentibus, calycis segmentis stylisque 6 distinguitur.

Caulis lignosus crassus abbreviatus, ramis brevibus, dense 4—6 foliatis; folia erecta inaequalia majora saepe subacinaciformia; valde compressa, obtuse carinata, altero latere plana, altero convexa, basi semiteretia purpurea, apice demum oblique rotundata, laevissima glauca, ad 6 cm. longa, 1 cm. lata, 2·4 cm. diam.; flores brevissime pedunculati, bibracteati, bracteis demum floriferis connatis, 0·7 cm. longis; calyx clavatus, 1·5 cm. longus, segmentis 5, subaequilongis acutis, 0·5 cm. longis, exterioribus late ovatis, ceteris lanceolatis, anguste membranaceo-marginatis; petala 2—3 seriata, interiores exterioribus paullo breviores, lineari-spathulata obtusa lutea, basi albida, 2—2·2 cm. longa; stamina pluri-seriata conferta 0·8 cm. longa, filamentis medio parce barbatis; glandulae 5, parvae, sature virides; ovarium subconico-convexum, obtuse 5 angulatum, stylis 5, filiformibus stamina parum excedentibus.

Cape Province: Karroo Region; Prince Albert, *Anna M. Tugwell*; (without flowers) *J. W. Matthews*. Flowered in National Bot. Gardens, Kirstenbosch, Jan., No. $\frac{4439}{14}$.

Most probably allied to the little known *M. obtusum*, Haw., but the strongly compressed older leaves, flat on one side and convex on the other with the resulting oblique keel, the 6 calyx-segments and styles amply distinguish our species.

Geigeria obtusifolia, L. Bolus (*Compositae-Inuleae*), ad *G. pectideam*, Harv. proxime accedit, sed foliis latioribus oblongis obtusissimis, capitulis solitariis, multo majoribus differt.

Suffrutex viscidulo-hispidulus pilis crispulis; rami diffusi elongati foliosi, ad 20 cm. longi, internodiis 0·4—1·5 cm. longis; folia patentia demum reflexa, oblonga vel rarius late linearia, basi vix angustata, subamplexicaulia, rarius breviter decurrentia, obtusissima subpungenti-mucronata, marginibus saepe undulatis, glandulis sessilibus nitentibus sparsa, 1·5—3 cm. longa, 0·5—1 cm. lata; capitula solitaria apicibus ramorum et brevium ramulorum, folio supremo approximato, 1·3 cm. longa; involucrum, parte globoso, 0·8—1 cm. diam., squamis exterioribus foliaceis, linearibus vel lineari-oblongis, saepe paullo angustatis infra medium, basi dilatatis, interioribus chartaceis discoloratis, ovatis vel lanceolatis setaceo-acuminatis ciliatis, ad 1·1 cm. longis; receptaculum subconvexum dense setosum; achaenia villosa, 0·15 cm. longa; pappi squamae 10, interiores aristatae, aristis squamis ipsis brevioribus.

Kalahari Region: Orange Free State; Smitskraal 809, Boshof Dist., fl. April, *J. Burtt Davy* (Colonial Herbarium, No. 10,118). Bechuanaland, near Mafeking, fl. March, *F. Bolus* (Bolus Herbarium, No. 6427).

Very closely allied to *G. pectidea*, Harv., but differs in having broader, usually oblong, very obtuse leaves, always solitary much larger heads which terminate the branches and short branchlets. Plate XIV, B.

Protea Tugwelliae[1], Phillips (*Proteaceae-Proteeae* § *Pinifoliae*) a *P. pityphylla*, et *P. witzenbergiana*, foliis et bracteis involucri distincte pubescentibus differt.

Rami glabri; ramuli glabri vel paullo pilosi. Folia 4·5—8 cm. longa, supra 1—2 mm. lata, linearia, apice mucronata, subobtusa, basi attenuata, glabra. Capitulum solitaria, terminalia, 3·7 cm. longum, circa 4·5 cm. latum; receptaculum convexum. Involucri bracteae 5-seriatae, pubescentes; extimae in aciem foliosum longum productae; interiores lineari-spathulatae, concavae, calyce longiores. Calycis tubus 1·8 cm. longus, supra glaber, membranaceus, trinervosus; infra dilatatus, 5-nervosus, supra villosus, infra glaber; laminae 1 cm. longae, aliquando glabrae aliquando paullo pilosae, apice triaristatae barbataeque; aristae laterales 2·5 mm. longae, villosae; media 1·5 mm. longa, filiformis, villosa. Stamina omnia fertilia, subsessilia; antherae 5·5 mm. longae, lineares, apice glandibus 6 mm. longis ovatis obtusis instructae. Ovarium 2 mm. longum, pilis longis vestitum; stylus 1·8 cm. longus, subfalcatus, supra semiteres, infra compressus, basi planus crassusque; stigma 5 mm. longum, apice obtusum.

Cape Province: Prince Albert Division, Zwartberg Pass, June, *Anna M. Tugwell* (Bolus Herbarium, No. 13382).

This species resembles *P. pityphylla*, Phill. and *P. witzenbergiana*,

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[1] By permission of the Trustees of the South African Museum.

Phill. in having the outermost involucral bracts produced into long foliaceous appendages but differs from both in the shape of the leaves and by having pubescent bracts.

It is a prostrate plant with yellowish bracts and was found by Mrs A. D. R. Tugwell in whose honour the species has been named.

Thesium lacinulatum, A. W. Hill; *T. rigido*, Sonder, quoad habitum simile ramis et floribus minute puberulis segmentis perianthii lacinulatis distinctum.

Suffrutex perennis circiter 30 cm. altus, omnino indumento minute puberulo obtectus, ramis et ramulis rigidis apice spinosis. Folia squamiformia, ramis appressa, subulato-lanceolata, 1·5—2 mm. longa, apice fusca. Flores axillares, solitarii, subsessiles; bracteae squamiformes floribus multo breviores bracteolae subulatae, cartilagineae, circiter 0·65 mm. longae. Perianthium 1·75 mm. longum, extra hirsutum, segmentis 1 mm. longis ovatis subacutis patentibus marginibus lacinulis membranaceis instructis. Antherae 0·4 mm. longae, segmentorum perianthii basin insertae. Stylus 0·25 mm. longus, conicus. Fructus ovoideo-globosus, 2·5 mm. longus, viridis, puberulus, costis 10 distinctis et reticulationibus inconspicuis instructus.

Namaqualand, Great Karasberg, *H. H. W. Pearson* (Percy Sladen Memorial Expedition 1912—1913, No. 7805).

Pterygodium MacLoughlinii, L. Bolus (*Orchideae-Corycieae*), *P. Volucris* affine sed foliis floribusque majoribus, partibus labelli diversis, facile distinguitur.

Herba erecta glabra, ad 23 cm. alta; caulis strictus, basin versus 1—2 vaginatus, 2—3 foliatus, internodiis exsertis 2—3 cm. longis; folia adscendentia vel patentia, ovata acuta vel late ovato-elliptica, 6—9 cm. longa, 2·5—5·5 cm. lata; spica dense vel sublaxe 6—16 fl., floribus adscendentibus vel suberectis; bracteae foliaceae reflexae; sepala lateralia patentia, oblique late obovata, 0·9 cm. longa, impari erecto ovato, lateralibus aequilongo: petala erecta concava, circuitu fere orbicularia, obliqua, saepissime breviter 2-loba, lobo inferiore late rotundato, margine undulata, 1 cm. longa, 0·9 cm. lata; labelli limbus 3-partitus, lobo intermedio deflexo ovato, apicem versus sensim attenuato, lateralibus brevioribus, subteretibus acutis, appendice erecto, anteriore obtuse carinato, apice subreflexo excavato, excavatione in dimidia divisa; rostellum transverse lineari-oblongum utrinque lobo libero glandulas obtegente donatum; anthera fere erecta, glandulis inferis; stigmata duo antica, basi loborum liberorum rostelli posita.

Cape Province: Eastern Mountain Province Region; Drakensbergen, Fikilemutu Pass, Matatiele Div., 7500 ft., fl. Feb., *A. G. McLoughlin*, 202.

A very distinct species allied to *P. Volucris*, Sw., having the suberect anther of that species with the gland situated below, but readily distinguished by the larger leaves and flowers and the differently shaped parts of the lip.

The curious free lobes, which cover the glands but can very easily be pushed aside, are very similar to those which are described in *P. Volucris* as being at the base of the limb of the lip. In *P. MacLoughlinii*, however, the lobes appeared clearly to be on the rostellum and to arise from near the stigmas. Plate XVII.

Geissorhiza Patersoniae, L. Bolus (*Irideae-Ixieae*) habitu robustiore, perianthii segmentis acuminatis, dilute lilacinis, seminibus late alatis, distinguitur.

Cormus globosus vel globose ovoideus, 0·8—1·2 cm. diam.; caulis flexuosus vel rarius strictus, in genere, subrobustus, ad 0·2 cm. diam., cum ceteris partibus glaberrimus, ad 47 cm. altus; folia 4—6, erecta, inferiora approximata, superiora distantia, plus minusve reducta, vaginantia, vaginis nervosis, laminis anguste linearibus acuminatis uninerviis, ad 34 cm. longa, 0·1—0·2 cm. lata; spica simplex vel e folio supremo furcata, laxiuscule 2—10 fl., floribus equilateralibus; spathae valva inferior oblonga herbacea, angustissime membranaceo-marginata, basi tantum viridis, superne subpurpurea, 1—1·7 cm. longa, superior apice bidentata vel biloba, apicem infra viridis, 0·9—1·5 cm. longa; perianthium 2—2·6 cm. longum, tubo 0·4—0·6 cm. longo, segmentis lanceolatis vel ovato-lanceolatis, acuminatis, pagina superiore dilute lilacina, purpureovittatis, pagina inferiore glaucis; stamina parum ultra perianthii dimidium attingentia, antheris 0·4—0 5 cm. longis; ovarium 0·4 cm. longum; stylum evolutum 0·9 cm. longum, ramis fere ter longius; capsula oblonga, basi apiceque parum angustata, ad 1·1 cm. longa, 0·4 cm. diam., seminibus subglobosis, late alatis.

Cape Province: South-Western Region; Riversdale Div., *J. Muir*, 1050; in clay soil on stony hillsides nr. Riversdale, alt. 850 ft., fl. Oct., *H. Bolus*, 11,385; *N. S. Pillans*. Uitenhage Div., Redhouse, fl. Sept., *Florence Paterson*, 47; nr. Port Elizabeth, fl. Sept., *E. Kensit*, 2.

Distinguished by the rather robust habit, acuminate pale lilac perianth-segments, and broadly winged seeds. This species is interesting as showing some affinity to *Gladiolus*, which the specimens in the dried state somewhat resemble. Living material, however, exhibits the regular perianth and equilateral stamens characteristic of *Geissorhiza*.

Gladiolus Muirii, L. Bolus (*Irideae-Ixieae*). *G. tenui* affinis, sed foliis 4—6, tubo perianthii breviore, segmentis exterioribus interioribus distincte longioribus, differt.

G. involutus de [illegible]

Cormus globosus, 1·2 cm. diam.; caulis flexuosus, cum ceteris partibus, glaberrimus, ad 62 cm. altus, 0·2—0·3 cm. diam.; folia 4—6, erecta linearia acuminata, marginibus leviter incrassatis, ad 48 cm. longa, 0·3—0·6 cm. lata; spica simplex vel 1—2-furcata, laxiuscule 4—6-fl., aequilateralis; spathae valvae lineari-lanceolatae, acutae vel acuminatae, 3—4 cm. longae, superiores minores; perianthium dilute carneum, 3—5 cm. longum, tubo 1—1·8 cm. longo, segmentis obtusis, apice recurvis, exterioribus interioribus distincte longioribus, lateralibus ovalibus, supra medium subabrupte angustatis 2—3·4 cm. longis, 0·9—1·5 cm. latis, superiore cucullato 1·5—2·7 cm. longo, inferioribus late linearibus, apicem versus leviter angustatis, virido-luteis carneo-notatis, interioribus ad 2 cm. longis, 0·5 cm. latis, exteriore 2·7 cm. longo; stamina ultra dimidium perianthii attingentia; ovarium 0·4 cm. longum; capsula oblonga obtusa, 1·1 cm. longa, seminibus subplanis, late alatis.

Cape Province: South-Western Region; Riversdale Div., Tweekuilen, fl. Sept., *J. Muir*, 588. South-Eastern Region; Uitenhage Div., near Redhouse, fl. Sept., *Florence Paterson*, 160.

Allied to *G. tenuis*, Baker, but differs in having more leaves, shorter perianth tube and the outer segments considerably longer than the inner.

## NOTES ON IMPERFECTLY KNOWN SPECIES

### By L. BOLUS

Plumbago tristis, Ait., Hort. Kew. ed. 2, 1. 324. Cape Province: Karroo Region; nr. Prince Albert, on the roadside between P. Albert and Fraserberg, fl. Sept., *Anna M. Tugwell* (Bolus Herbarium, No. 13,488).

Racemes up to 10 cm. long, 16-fld., the rhachis flexuous; lobes of the corolla obovate subtruncate, 0·8 cm. long. Plate XIV, C.

This plant was originally collected by Masson, probably on his third journey when he crossed the Karroo from the Roggeveldbergen to the Bokkeveld. The refinding of *Phaeocephalus gnidioides*, sp. Moore, previously only known from Masson's collection, near Prince Albert, was a parallel case.

Holubia saccata, Oliver, Hook. Ic. Pl. t. 1475. Kalahari Region; Bechuanaland; Mochudi, fruiting May, *W. H. Harbor* (F. A. Rogers, No. 6450).

Capsule amply 4-winged, up to 4 cm. long, 5 cm. wide, 16-seeded, seeds obovate-cuneate, crenulate on the margin, alveolate. Plate XIV, D.

# NATIONAL BOTANIC GARDENS

## AN OLD CAPE FRONTIER

By E. A. WALKER, M.A.

Cape Colony has had her fair share of variety in frontiers. True, she has never sheltered herself behind the rigid magnificence of a great wall, nor was the canal which was to sever the Peninsula from Africa ever dug; but apart from these alternatives, she has run through the list from wire fences to lines of latitude, and from shallow rivers to belts of neutral territory. The earliest and perhaps the most interesting boundary line was the hedge of wild almonds and thorn bushes with which van Riebeeck sought to enclose "the whole settlement, with its agriculture and forests...as in a half-moon[1]."

Part of this old frontier is still marked by a high almond hedge which runs from the banks of the Liesbeeck in the National Botanic Gardens to the Hen and Chickens rocks. Thence it once turned northward and ran towards the mouth of Salt River. Possibly scattered fragments remain in suburban gardens, but as a hedge, the frontier survives only on its southern side. In its early stages again it is much broken and throughout its main course it is overrun with trees and undergrowth. As an ancient landmark in Cape history it is worthy of a better fate.

The hedge formed van Riebeeck's attempt to solve the apparently insoluble. On the one hand he was ordered to keep on good terms with the Hottentots with a view to the cattle trade; on the other he had to protect the Company's cattle and the farms of the Free Burghers, which in 1659 stretched along both banks of the Liesbeeck as far as the Commander's own vineyard and cornlands "lying on the farthest frontier" on the slopes of the Bosheurd[2], that hill "which has a view over the whole flat between False and Table Bays[3]." Weary of calling out the burghers to assist the troops against "dull, stupid, lazy and stinking natives" who yet contrived to escape

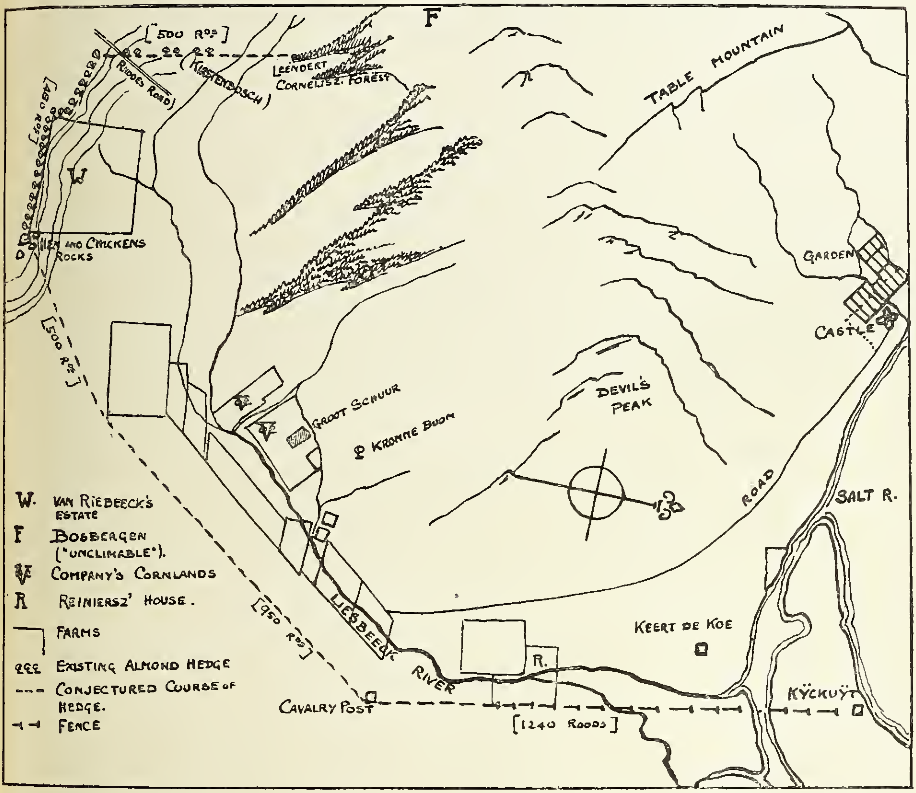
[1] Van Riebeeck's *Journal*, Part III. p. 111, translated by J. C. V. Leitbrandt.

[2] The high ground running eastwards from Kirstenbosch towards Wynberg Hill. Van Riebeeck's estate was also called Bosheurd, afterwards Protea and now Bishop's Court. Cp. Theal, *History of S. A. before* 1795 (ed. 1909), II. 87, III. 498.

[3] *Journal*, III. 15.

his ambuscades and "knew how to avoid the bullets by dodging[1]," van Riebeeck turned to artificial defences for better security.

The defences were twofold. Towards the close of 1659 a fence of poles was built from the sea-shore near the mouth of the Salt River to Jan Reiniersz' house at the junction of the Liesbeeck and the spruit of the Salt River; beyond that point the Liesbeeck was cleared of weeds and the banks made steeper, while from the Kromme Boom the fence was begun again and ran for 600 roods up to the primeval forest which in those days clothed the eastern slopes of Table Mountain. It was this fence which was strengthened by the famous blockhouses: Kÿckuÿt on a high sänd-hill near the sea-shore "between Salt River and the beach"; Keert de Koe between Salt River and the Liesbeeck; Hond den Bul at some point nearer the forest.



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[1] *Journal*, III. 27.

All these barriers were on the Cape Town side of the Liesbeeck excepting the line from Reiniersz' house to the sea; but it was the farmers living beyond the river who stood most in need of protection. Accordingly the order went forth that all farms were to be fenced and "all open lands not belonging to anyone shall for greater security be fenced...with pega-pegas or bitter almond trees[1]." Van Riebeeck had the area of the settlement measured off from Kÿekuÿt around the lands of the Freemen "to the principal projected cavalry watchhouse and over the back of the Bosheurd as far as the Bosbergen to the forest of Leendert Cornelisz inclusive." Round this line a strip one rood in breadth was to be ploughed and planted with bitter almond trees and all kinds of thorn bushes "so that it will be in the form of a fence or enclosure, just as in Germany...some Counts and Lords mark off their jurisdictions[2]."

The Company's servants and burghers were assisted in their labour of bringing the trees from the banks of the mountain streams, where the bitter almond still grows, by some wrecked French sailors who, partly to pay for their keep but mainly "for pregnant reasons," were pressed into the service[3]. Van Riebeeck, like other Governors after him, evidently believed that a Frenchman was least dangerous when he had most to do. By December, 1660, the Commander was able to speak of "our present limits which have been already planted with bitter almonds as a protecting fence[4]."

The hedge proved hardly more effective than other South African boundaries: the Europeans insisted on getting out; indeed while the work was progressing, van Riebeeck was riding out "to see how far that fence might be extended[5]"; while in spite of strict orders to keep "behind the Bosheurd" and "outside the landfence now being planted[6]," the Saldanars grazed their cattle within the boundary and the Kaapmen, "camped near the Bosheurd, had trodden down the whole plantation[7]." Van Riebeeck's attempt at segregation was hardly a success.

No certain answer can be given to the question whether the almond trees in the existing hedge were planted in 1660. The trees themselves give no definite clue to their age. On the other hand the shoots are in many cases more than 20 feet high and at the base thicker than a man's body. Bush-fires from time to time must have swept away all that showed above ground; there are signs that part of the hedge has suffered so recently. The roots are certainly much older than the shoots.

None of the maps available show the hedge and fence as a whole[8]. On the other hand the map of 1660—1 shows part of it, while the existing hedge fits into the detailed measurements given by van Riebeeck himself of the area thus surrounded. The entire circumference was 3673 roods; that is from the sea at Kÿekuÿt to the "principal projected cavalry watch house," 1320 roods and for the rest 2353 roods. The later map of 1660—1 shows the line of fencing running from the sea-shore to the cavalry post (Muÿterborst) which had by that time been established near the Rondebosch Camp Ground, a distance of 1240 roods. From the watch-house to the Hen and Chickens rocks at the corner of the Bosheurd estate, where the existing hedge runs, is 1450 roods. Some 980 roods have to be accounted for. The hedge at the present moment runs along the boundary of van Riebeeck's estate for 480 roods to a point near the Rhodes road where it turns off at an angle of about 110°. A line of 500 roods laid out at the necessary angle on the map of 1660—1 reaches Leendert Cornelisz forest. This last portion survives to-day as a broken line of hedge ending on the banks of the Liesbeeck in the Kirstenbosch estate.

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[1] *Journal*, III. 90—1.
[2] *Ibid.* III.; *Letters Despatched* III. 140.
[3] *Journal*, III. 136.
[4] *Ibid.* 198.
[5] *Ibid.*
[6] *Ibid.* 176, 269.
[7] *Ibid.* 307—8.
[8] Nos. 807, 808. Copies in the Cape Archives; originals in the Royal Archives at the Hague.

The estate of Bosheurd was certainly protected by a hedge of wild almonds; it is still protected by such a hedge; that hedge was the boundary of the settlement, and the present hedge holds to the top of the ridge, the natural and only place for a boundary if a view over the whole of the Flats was to be had thence. The only conclusion is that if the existing bushes were not planted in 1660, they are successors of those that were so planted. In view of the size of the roots there is no reason, botanically speaking[1], why the hedge should not be the remains of the living boundary planted by the Cape's first Commander.

## POSTSCRIPT

The "wild almond," of which the hedge described above by Professor Walker is composed, is a native proteaceous shrub, *Brabeium stellatifolium*, L., the only species of a genus endemic in the south-western coast region. It has the habit of a shrub which in favourable situations attains a height of 20 ft. or more. The branches, arising from a "rootstock" which in old plants becomes very massive, frequently attain a diameter of as much as 1½ or 2 ft. and a length of 30 or 40 ft.; in such cases however they are usually prone, and in this way a single bush may cover a very large area. Growth is rapid and the wood somewhat soft, containing much water, and of a reddish colour. According to Pappe the wood "is fit to be used for ornamental joiners' and turners' work. As yet it has been little employed except as firewood."

It is particularly partial to the neighbourhood of water and is abundant on the banks of mountain streams, where it attains its most luxuriant form. It nevertheless grows quite readily in comparatively dry situations in which however it is doubtful whether it occurs naturally. Once established it is eradicated with difficulty. The plants constituting the hedge now under notice have without doubt been cut or burnt to the ground many times since they were planted. But after each catastrophe the rootstocks have produced new growths of aerial branches.

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[1] I state this on the authority of Dr H. H. W. Pearson, Director of the National Botanic Gardens.

Consequently it is impossible to obtain direct botanical evidence as to the age of these bushes. That they constitute an artificial hedge is clear from the nature of the line followed along a ridge bearing no other plants of this species and where the conditions are those in which demonstrably wild plants are never found. Probably none of the hedge-plants bears an aerial branch with more than 20 xylem-rings. But the massive misshapen rootstocks, usually many feet in horizontal diameter and of unknown depth, show no characters which can be used to discredit the current tradition that this is the remains of the original hedge of van Riebeeck.

The common name "Wild almond" (cf. *Amygdalus aethiopica*, Breyne) owes its origin to the resemblance of the drupe to that of the true almond. Pappe states that the fruit "having been soaked for some days in water, is eaten by the natives, being obnoxious when quite fresh. The kernel when roasted is used as coffee."

H. H. W. P.

# REVIEW

## AN OECOLOGICAL SURVEY OF THE MIDLANDS OF NATAL, WITH SPECIAL REFERENCE TO THE PIETERMARITZBURG DISTRICT.

By J. W. Bews, M.A., D.Sc. (Edin.). (Reprinted from *Annals of the Natal Museum*, Vol. II. Part 4. August, 1913.)

In his analysis of the vegetation of the Midlands of Natal, Professor Bews brings out strikingly the difference between the various vegetational components, and makes a number of extremely interesting observations.

His disentanglement of the different factors influencing the vegetation, and particularly the influence of man upon it, is most illuminating.

The region dealt with is divisible into two main portions, High and Low Veld, which are edaphically and climatically quite distinct. The High Veld has a deeper, lighter soil and a heavier rainfall than the Low Veld, the soil of which tends to be shallow and baked.

The Low Veld is particularly adapted for the cultivation of maize, while on the High Veld, Wattle (*Acacia mollissima*) is grown, the bark being used for tanning and the timber for mine props.

Both the High and Low Veld bear grass-lands characterised by the dominance of the grass *Anthistiria imberbis*, but the form of the plant in the two regions is very distinct. It is interesting to note that in the transitional region between High and Low Veld, the Anthistiria is replaced by species of Andropogon.

The woodland of the High and Low Veld is quite distinct. In the High Veld it is a close bush, intermediate in character between Sclerophyllous Woodland and Tropical Rain Forest, with a slight tendency to become deciduous.

The Low Veld is characterised by a very open scrub called "Thorn Veld." The factor which keeps the Thorn Veld thus open seems to be the constant recurrence of bush fires.

Besides the types Veld, Bush and Thorn Veld, already alluded to, Professor Bews also distinguishes special Rocky Hillside, Alpine Vlei, and Stream formations.

The distinctions he draws seem to be perfectly just, but it is with his basis of classification that the reviewer has fault to find.

The definition of what constitutes a formation does not remain constant throughout the article. On page 254 the sentence "though the trees and grasses, since they occupy the same habitat, together constitute one formation..." seems clearly to indicate that difference in habitat constitutes difference between formations, yet we find the Grasslands of the High and Low Veld (very different climatically and edaphically) put together as one, "The Veld," formation. In this case therefore the growth form seems to be taken as the basis for a formation. On the other hand, the woodland of the High Veld and Low Veld ranks as two separate formations, the Bush formation and the Thorn Veld formation, though why the two woodlands should be raised to formational rank, which is denied to the corresponding grasslands, is not apparent.

To have kept to a climatic and edaphic basis for the formation throughout would have seemed the simplest course, placing the grassland and woodland of High Veld in one formation and those of Low Veld in another. This procedure would have been in accordance with the historical concept of the formation, favoured by British ecologists, for Professor Bews indicates that much of the existing grassland is retrogressive scrub and that retrogression to grassland is still going on.

The difficulty in establishing a High Veld and Low Veld formation seems to have been that the vegetation of the Vleis, streams and rivers of the two regions shows little or no difference, but the establishment of a common Vlei formation in the midst of the two Veld formations does not seem so serious a source of confusion, as the mode of classification actually adopted.

E. M. M. Hume.

## EXPLANATION OF PLATES

### PLATE X

A. Lessertia Harveyana, L. Bolus. B. L. globosa, L. Bolus.

Fig. 1, sketch of branch—nat. size; 2, flower, side view; 3, calyx with pedicel; 4, calyx, laid open, inner view; 5, vexillum; 6, ala; 7, carina; 8, androecium; 9, gynaeceum—× 3.

### PLATE XI

A. Lessertia Thodei, L. Bolus. B. L. Dykei, L. Bolus.
C. L. Kensitii, L. Bolus.

Fig. 1, sketch of branch—nat. size; 2, flower, side view; 3, calyx with pedicel; 4, calyx, laid open, inner view; 5, vexillum; 6, ala; 7, carina; 8, androecium; 9, gynaeceum— × 2; 10, legume; 11, ditto, one side removed—nat. size; 12, flower, side view; 13, gynaeceum; 14, stipule— × 2.

### PLATE XII

A. Lessertia rigida, E. Mey. B. L. Flanaganii, L. Bolus.

A. Fig. 1, sketch of branch; 2, sketch of older portion of stem—nat. size; 3, flower, side view; 4, calyx with pedicel; 5, calyx, laid open, inner view; 6, vexillum; 7, ala; 8, carina; 9, androecium; 13, gynaeceum— × 2. B. Fig. 1, sketch of branch, nat. size; 2, flower, side view × 3; 3, calyx with pedicel; 4, calyx, laid open, inner view; 5, vexillum; 6, ala; 7, carina; 8, androecium; 9, gynaeceum— × 2.

### PLATE XIII

A. Lycium karasbergense, L. Bolus. B. Nemesia karasbergensis, L. Bolus. C. Manulea namaquana, L. Bolus.

A. Fig. 1, sketch of branch—nat. size; 2, calyx with part of pedicel × 2; 3, calyx, laid open × 3; 4, corolla, laid open × 2; 5, gynaeceum × 3. B. Fig. 1, sketch of branch—nat. size; 2, calyx and gynaeceum; 3, corolla, laid open × 3; 4, posterior lip; 5, capsule— × 2. C. Fig. 1, sketch of branch—nat. size; 2, corolla × 2; 3, corolla tube with stamens × 3; 4, gynaeceum × 4; 5, capsule × 2.

## PLATE XIV

A. Geigeria Pearsonii, L. Bolus. B. G. obtusifolia, L. Bolus.
C. Plumbago tristis, Ait. D. Holubia saccata, Oliver.

A. Fig. 1, sketch of branch—nat. size; 2, head; 3, 4, 5, 6, involucral bracts; 7, corolla of ray floret; 8, corolla of disk floret—×2; 9, 2 stamens; 10, style—×4; 11, achene and pappus × 8. B. Fig. 1, sketch of branch—nat. size; 2, head, the outermost bracts removed; 3, 4, 5, 6, 7, involucral bracts; 8, corolla of ray floret: 9, corolla of disk floret—×2; 10, 2 stamens; 11, style; 12, achene and pappus—×4; 13, inner pappus scale × 8. C. Fig. 1, leaf—nat. size; 2, calyx, laid open, outer view × 2; 3, limb of corolla and half of the tube × $1\frac{1}{2}$; 4, stamen; 5, gynaeceum—× 2; 6, fruiting calyx × $1\frac{1}{2}$. D. Fig. 1, capsule × $\frac{1}{2}$; 2, seed × 4.

## PLATE XV

A. Acmadenia obtusata, Bartl. and Wendl., var. macropetala, Glover.
B. Acmadenia heterophylla, Glover. C. Diosma Bolusii, Glover.
D. Diosma Guthriei, Glover.

A. Fig. 1, sketch of branch—nat. size; 2, sepal × 5; 3, petal × 2; 4, flower, sepals and petals removed × 4; 8, ditto, longitudinal section shewing developed style, × 6; 5, 6, anther, back and front view; 7, staminode—× 5; 9, capsule with calyx and bracts × 3; 10, leaf, dorsal view; 11, ditto, transverse section—× 4. B. Fig. 1, sketch of branchlet—nat. size; 2, sepal; 3, bract; 4, petal; 5, flower, sepals and petals removed—× 4; 6, 7, stamen, front and back view × 6; 8, leaf, dorsal view; 9, ditto, transverse section—× 4. C. Fig. 1, sketch of branch—nat. size; 2, sepal × 5; 3, petal × 6; 4, portion of flower × $2\frac{1}{2}$; 5, 6, anther, front and back view; 7, petals from a bud—× 6; 8, leaf; 9, ditto, transverse section—× 5. D. Fig. 1, sketch of branch—nat. size; 2, sepal; 3, petal; 4, portion of flower—×6; 5, 6, stamen, front and back view, × 10; 7, leaf, dorsal view; 8, ditto, transverse section —× 6.

## PLATE XVI

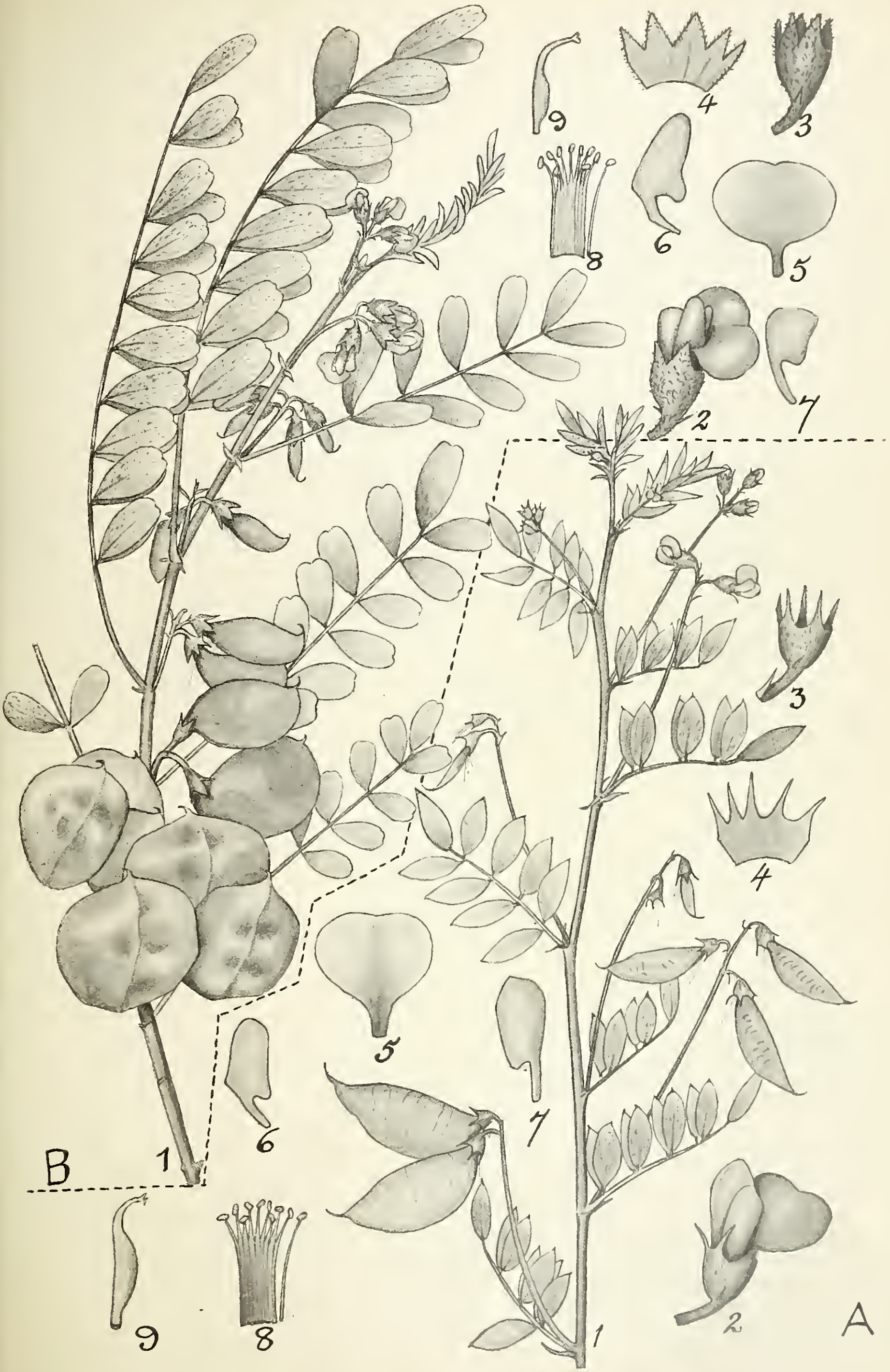
A. Argyrolobium Muirii, L. Bolus. B. Indigofera langebergensis, L. Bolus.

A. Fig. 1, sketch of shoot; 2, 3, leaf, upper and lower view—nat. size; 4, flower, side view; 5, calyx with pedicel—×2; 6, calyx, laid open, nat. size; 7, vexillum; 8, ala; 9, carina; 10, androecium; 11, gynaeceum—× 2; 12, ovary, one side removed, × 4. B. Fig. 1, sketch of branchlet; 2, older portion of stem—nat. size; 3, flower; 4, calyx with pedicel; 5, calyx laid open; 6, vexillum, lower view; 7, ala; 8, carina; 9, androecium; 10, gynaeceum—× 2.

## PLATE XVII

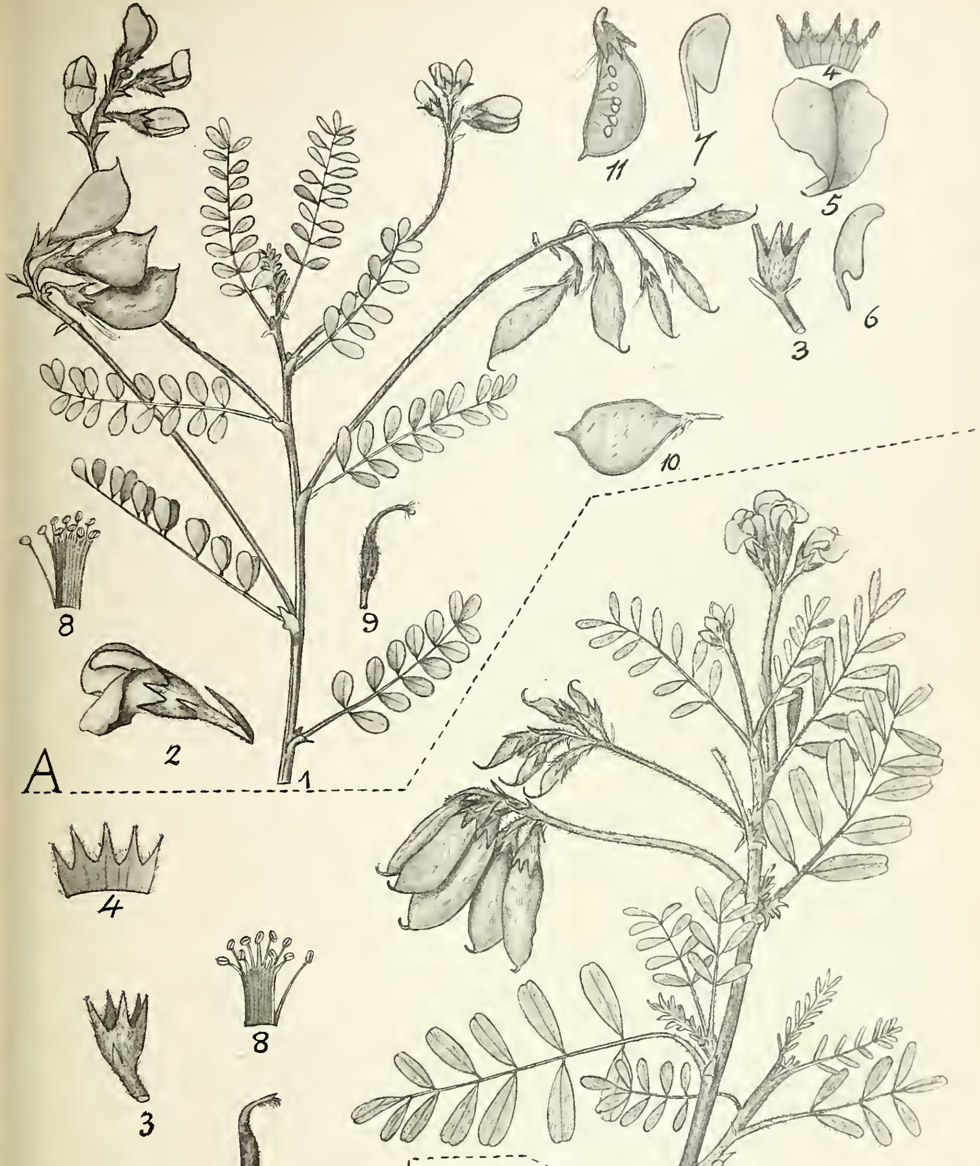
Pterygodium MacLoughlinii, L. Bolus.

Fig. 1, odd sepal; 2, side sepal; 3, petal; 4, lip, front view; 5, ditto, back view; 6, column and lip, front view; 7, ditto, back view; 8, appendage of lip, side view; 9, column, front view; 10, pollinium—variously magnified.



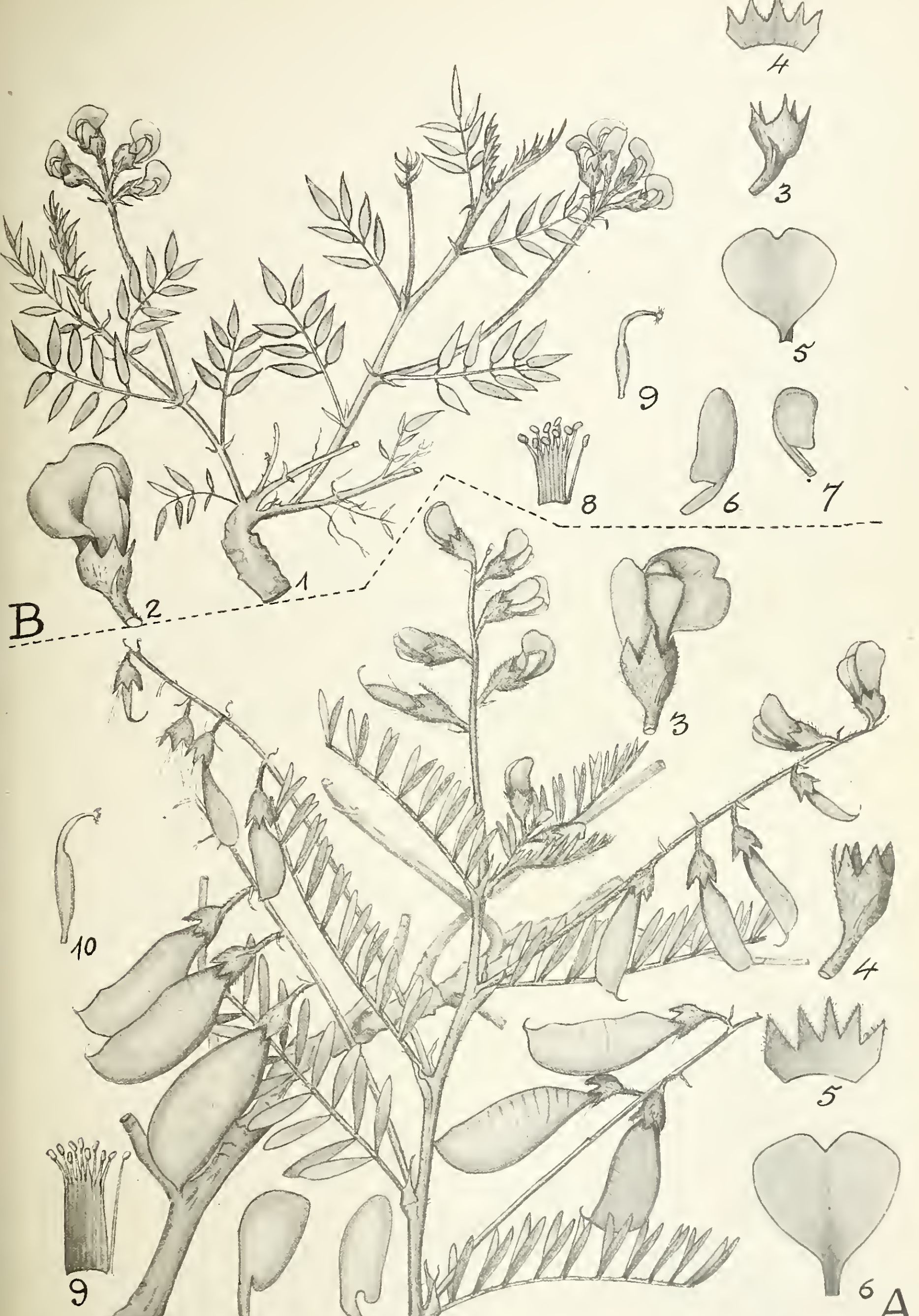
*A. C. Dawson, del. e sicco*

A. Lessertia Harveyana, L. Bolus B. Lessertia globosa, L. Bolus



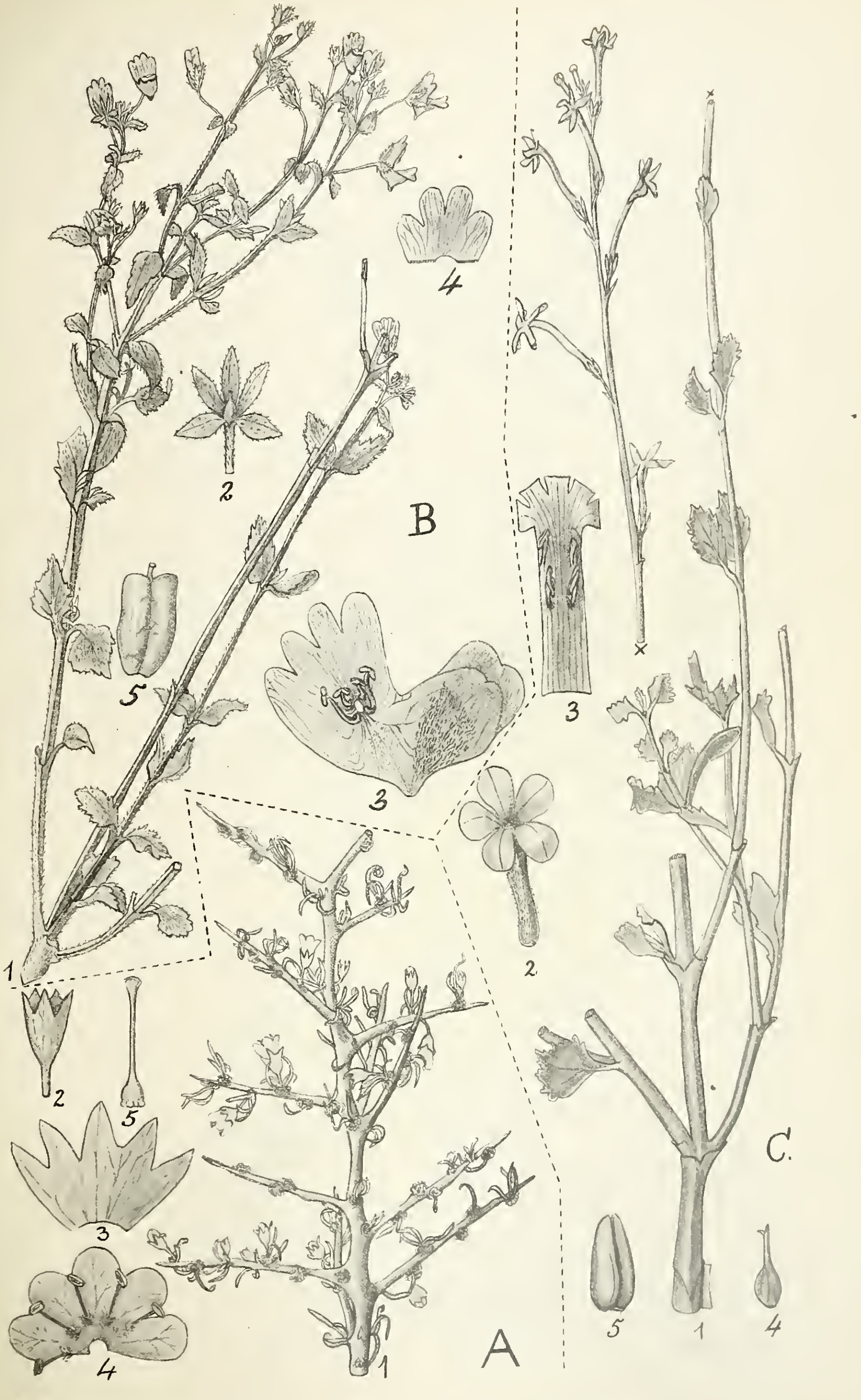
*A. C. Dawson, del. e sicco*

A. Lessertia Thodei, L. Bolus B. Lessertia Dykei, L. Bolus
C. Lessertia Kensitii, L. Bolus



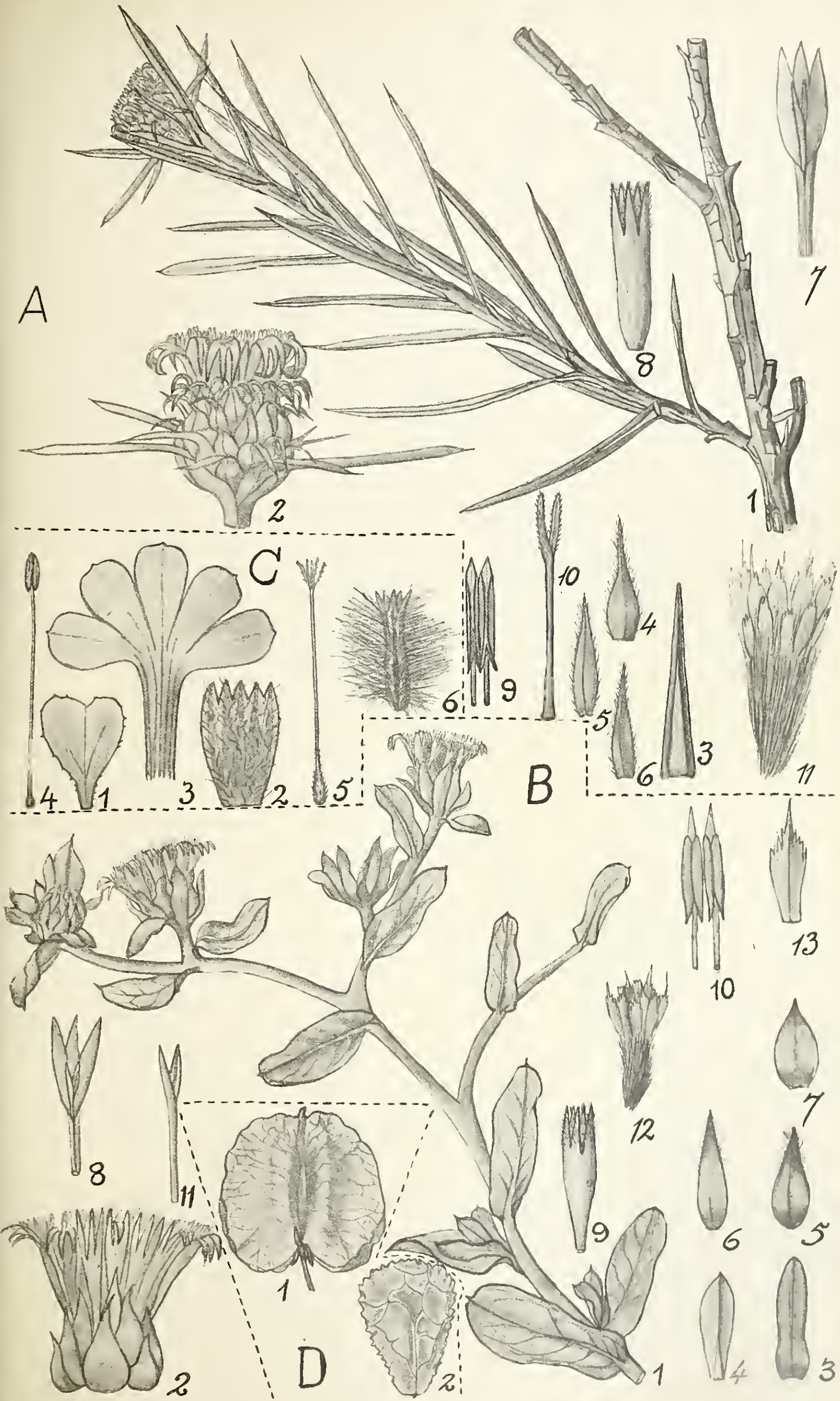
*A. C. Dawson, del. e sicco*

A. Lessertia rigida, E. Mey. B. Lessertia Flanaganii, L. Bolus



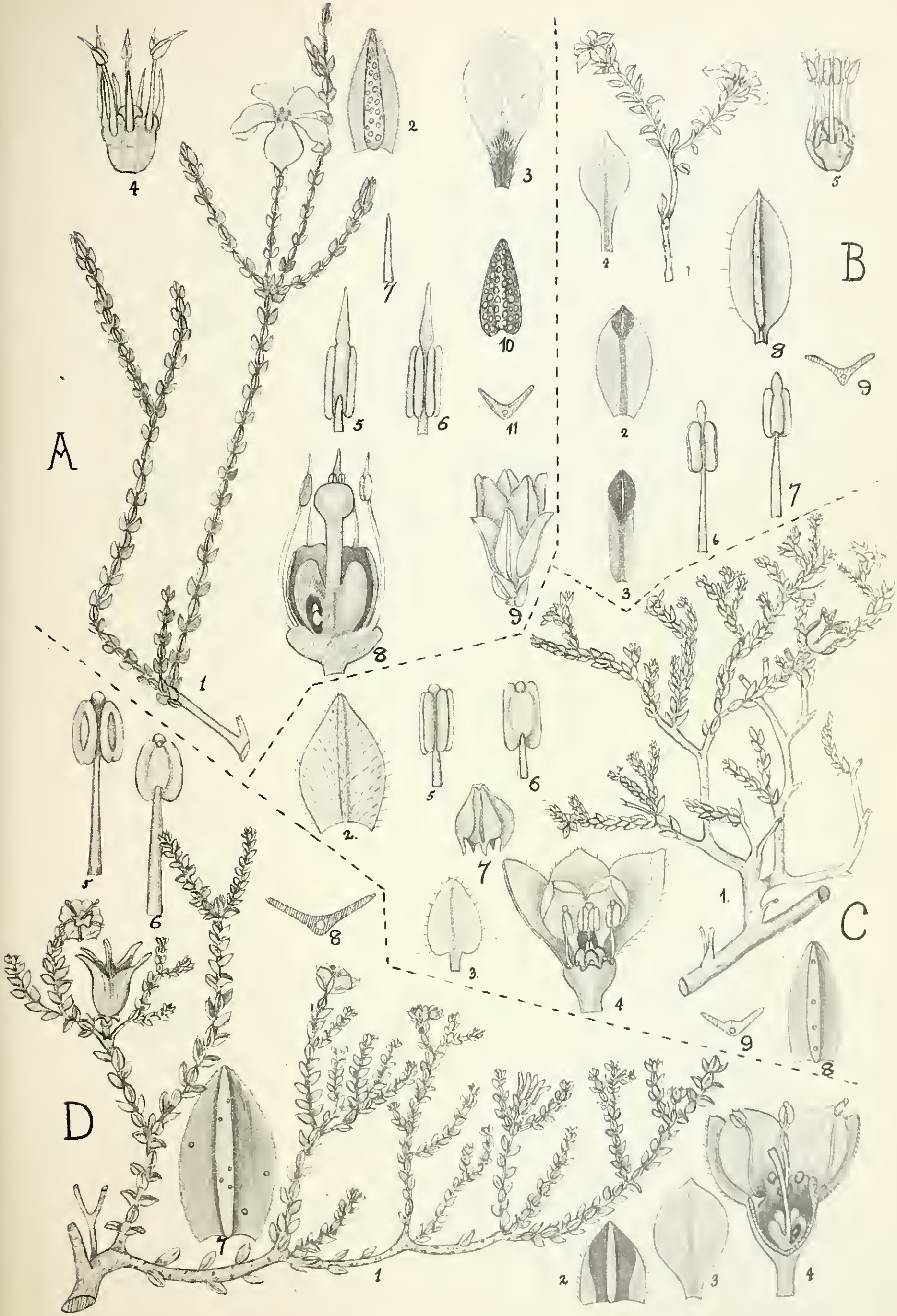
*M. W. Glover, del. e sicco*

A. Lycium karasbergense, L. Bolus. B. Nemesia karasbergensis, L. Bolus.
C. Manulea namaquana, L. Bolus.



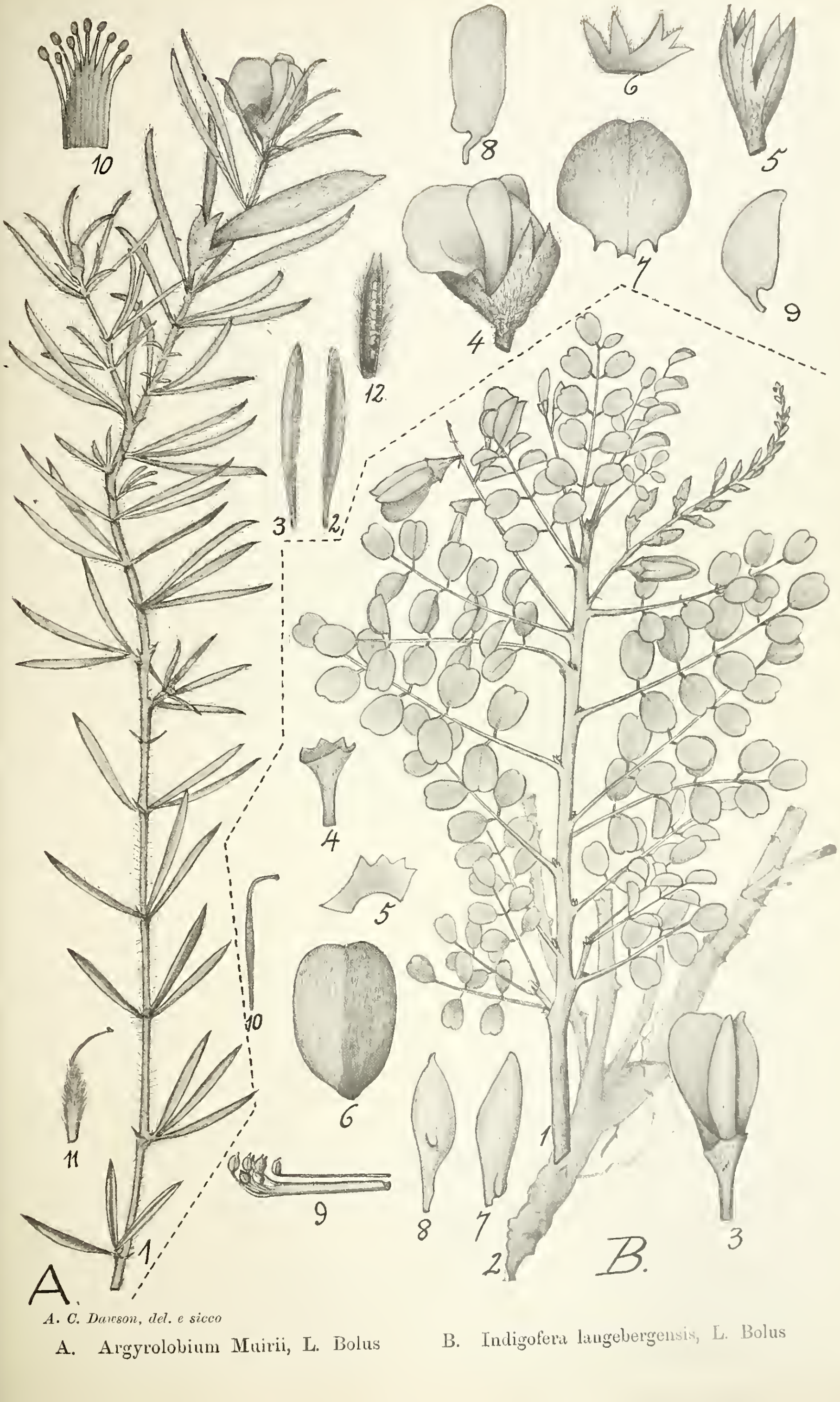
M. W. Glover, del. e sicco

A. Geigeria Pearsonii, L. Bolus
B. Geigeria obtusifolia, L. Bolus
C. Plumbago tristis, Ait.
D. Holubia saccata, Oliver



*G. Edwards, del. e sicco*

A. Acmadenia obtusata, B. and W., var. macropetala, Glover B. Acmadenia heterophylla, Glover
C. Diosma Bolusii, Glover D. Diosma Guthriei, Glover

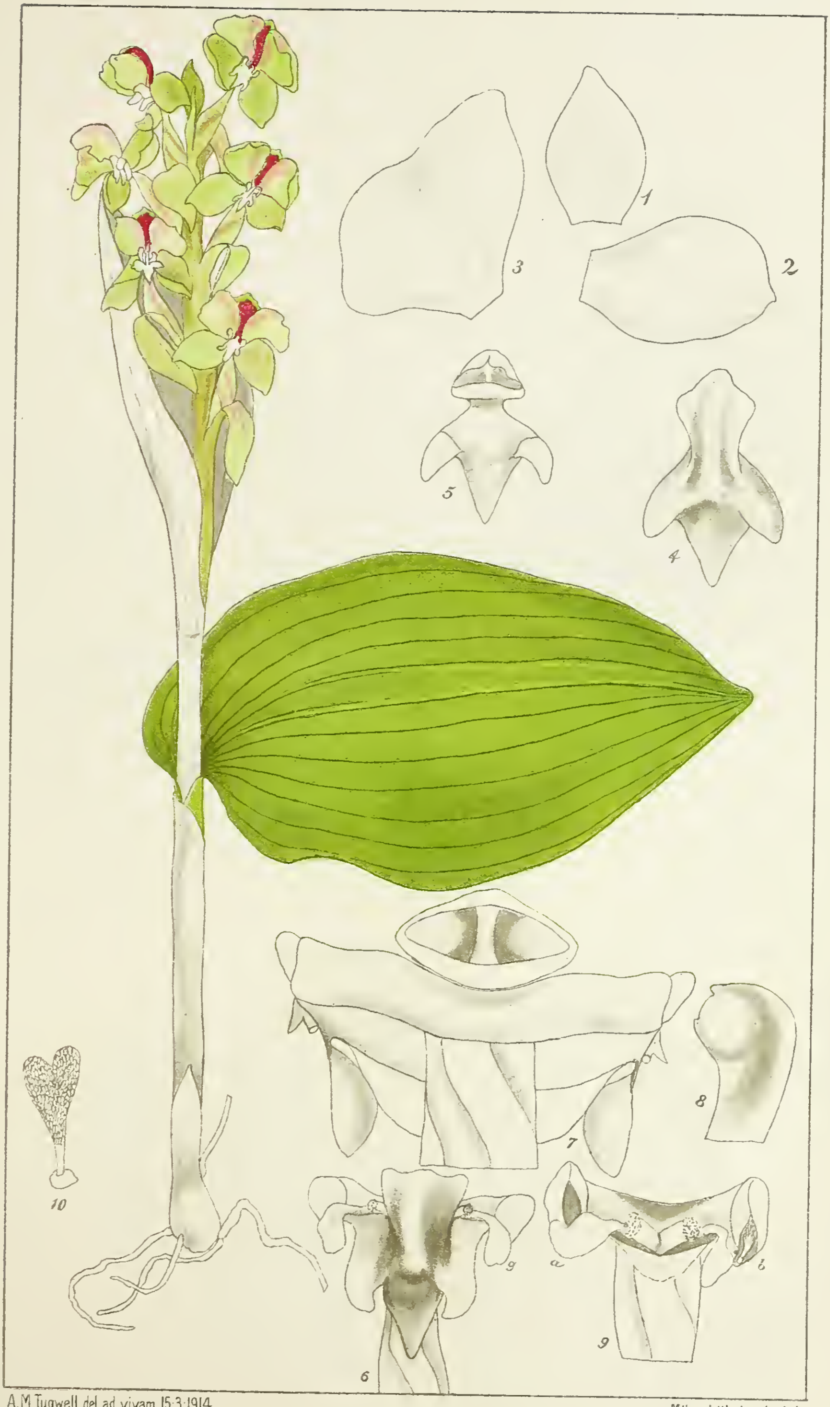


*A. C. Dawson, del. e sicco*

A. Argyrolobium Muirii, L. Bolus

B. Indigofera laugebergensis, L. Bolus

Plate XVII



A. M. Tugwell del. ad vivam, 15·3·1914.

Miles Lith., London, W.

PTERYGODIUM MACLOUGHLINII. L. BOLUS.

VOLUME I NOVEMBER, 1915 No. 4

# EXTRA-TROPICAL SOUTH AFRICAN ACACIAE

BY RUTH GLOVER

THE genus Acacia consists of about 450 species and is confined to tropical and subtropical regions. By far the greatest number of species occurs in Australia. According to Thonner (*Die Blütenpflanzen Africas*), there are 80 species in Africa, of which 24 occur in extra-tropical South Africa. All these are to be found in the Kalahari Region as understood by H. Bolus (*Science in South Africa*, 1905), and the great majority are recorded from the Transvaal. The most widely spread species, A. Karroo, Hayne (*A. horrida, Willd.*, the common karroo thorn) occurs as far south as Worcester in the west and Uitenhage Division in the east. This species has been found on the slopes of Lion's Mountain in the Cape Peninsula, but Bolus and Wolley Dod (*List of Flowering Plants and Ferns of Cape Peninsula*) regard it as "an outlier from the Karroo and doubtfully native."

Two species, A. haematoxylon and A. giraffae (Kameeldoorn) seem to be confined to the dry sandy plains of Bechuanaland. Several species including A. albida, A. pallens and A. lasiopetala are essentially tropical ones which have extended southwards.

In habit, most are erect trees or shrubs; two species, which extend from Natal along the coast-line into Mozambique (A. pennata, Willd., and A. Kraussiana, Meisn.) are scrambling suffrutices.

In this attempt to make a key for the South African species of Acacia, the character of the spines, as a distinguishing mark for a species, has been disregarded, as the spines vary considerably on the same plant and often the flowering branches do not bear spines at all or they are not developed until after the flowering period.

In A. caffra, Willd., true spines are never present, but prickles are usually developed in pairs below the foliaceous stipules. Prickles are usually present in A. eriadenia, Benth., and A. ataxacantha, DC., scattered irregularly over the branches and branchlets. Bentham (*Monograph of the Mimoseae* in

*Trans. Linn. Soc.* xxx) regards the spines of A. detinens, Burch., as prickles, but it has been proved by a series of transverse sections that these are true spines and not prickles. In A. spirocarpoides, Engl., there is greater variety than usual in the spines, for there occurs at the nodes either a pair of long straight white spines, or a pair of short recurved spines, or finally a long straight white spine with a short recurved spine. This species appears to me to be identical with the type specimen of A. heteracantha, Burch., in the Kew Herbarium. There is, however, no fruit of the latter at Kew and Burchell in his notes describes the legumes as "linear" and does not mention that they are spirally twisted. Both species are recorded from the same locality.

The species, A. Karroo, Hayne, and A. natalitia, E. Mey., seem to be very closely related and, in the dried state, are extremely difficult to distinguish. There may be distinguishing characters in the shape and size of the trees, but this, however, I have not yet been able to ascertain. In herbarium specimens of A. natalitia, the bark of the branchlets is usually light grey or whitish, while that of A. Karroo is dark brown. For the present, I have kept the two species distinct.

The same difficulty exists in the case of A. robusta, Burch., and A. clavigera, E. Mey., two very closely allied species. It is highly probable that A. clavigera may prove to be only a less robust form of A. robusta.

I am greatly indebted to Dr Stapf and Mr Craib of the Royal Botanic Gardens, Kew, without whose guidance and generous assistance I should not have been able to undertake the work.

- Stipules not spinescent (foliaceous or membraneous); stems furnished with prickles.
  - Erect trees; inflorescence spicate.
    - Prickles, when present, in pairs at the nodes; ovary glabrous. 4. caffra.
    - Prickles, when present, scattered; ovary pilose.
      - Pinnae 6—10 jugate. 5. eriadenia.
      - Pinnae 20—40 jugate. 6. ataxacantha.
  - Climbing or scrambling shrubs; inflorescence capitate.
    - Pinnae 3—5 jugate, leaflets oblong 6—12 jugate. 7. Kraussiana.
    - Pinnae 8—20 jugate, leaflets narrow linear, 30—35 jugate. 8. pennata.
- Stipules spinescent; stems not furnished with prickles.
  - Inflorescence spicate.
    - Leaflets obliquely rotund, 1·5—3 cm. wide. 1. pallens.
    - Leaflets oblong to linear, 0·1—0·5 cm. wide.
      - Leaflets obliquely rotund, not more than 0·5 cm. wide, up to 6 jugate. 2. Burkei.

Leaflets oblong, not more than 0·3 cm. wide, 14—16 jugate. 3. albida.

Inflorescence capitate.

Leaflets 1—2 jugate. 9. detinens.

Leaflets 7—∞ jugate.

Legume spirally twisted. 10. spirocarpoides.

Legume not spirally twisted, straight or falcate.

Leaflets less than 0·1 cm. long, canescent. 11. haematoxylon.

Leaflets more than 0·1 cm. long, not canescent.

Pods moniliform.

Pods dark brown or nearly black, disarticulating, > 1 cm. wide. 18. Benthami.

Pods pale brown, not disarticulating, < 1 cm. wide.

Pinnae usually less, sometimes up to 4 jugate. 24. Karroo.

Pinnae usually more than 4 jugate.

Pinnae < 10 jugate.

Leaflets ciliate 21. hirtella.

Leaflets glabrous 23. natalitia.

Pinnae 10 or more jugate. 20. Davyi.

Pods not moniliform.

Bark peeling off.

Bark dark brown peeling off showing yellow cortex; legume < 9 cm. long. 22. xanthophlaea

Bark light brown peeling off in layers; legume > 9 cm. long. 15. lasiopetala.

Bark not peeling off.

Legume falcate.

Legume < 5 cm. long; sprinkled with conspicuous, sessile glands. 16. glandulifera.

Legume > 5 cm. long; not or only microscopically sprinkled with sessile glands.

Legume < 2 cm. broad. 19. Gerrardi.

Legume > 2 cm. broad. 12. giraffae.

Legume not falcate.

Legume ± densely pubescent; leaflets < 0·7 cm. long. 17. hebeclada.

Legume glabrous; leaflets > 0·7 cm. long.

Legume 2·5 cm. broad, 9·5 cm. long. 13. robusta.

Legume < 2·5 cm. broad, 14 cm. long. 14. clavigera.

1. A. pallens, Rolfe, Kew Bull. 1907, 361. Plate XIX, fig. 14.

Kalahari Region: Transvaal, Zoutpansberg, Lebombo Flats, *C. E. Legat* (Colonial Herbarium, 608). Barberton, *Burtt-Davy*, 1022.

*Galpin*, 542. Barberton Div., Hyslops Creek, *Thorncroft*, 678. Komati Poort, *Burtt-Davy*, 2452. Bechuanaland, Topsi, *Burtt-Davy*, 1367.

2. A. Burkei, Benth., Lond. Journ. v. 98. Plate XVIII, fig. 4.

Kalahari Region: Transvaal, Magaliesberg, *Burke*, 126. Nylstroom to Springbok Flats, *Burtt-Davy*, 1731. Nylstroom, *Transvaal Museum Herbarium*, 2983. Potgietersrust, *Burtt-Davy*, 5239.

3. A. albida, Delile, Fl. Eg. 142, t. 52, f. 3. Plate XVIII, fig. 12.

Kalahari Region: Bechuanaland, Mochudi, *Harbor* (*Transvaal Museum Herbarium*, 14094).

This is the only record of this species occurring south of the tropic, but it occurs abundantly in the tropics, where it is known as the "Anna tree." The legumes are collected as valuable food for stock.

4. A. caffra, Willd., Sp. Pl. IV. 1078. Sim's Forest Flora, t. 60. Plate XVIII, fig. 6.

South-western Region: George Div., Blauw Krantz, *Mrs Salisbury*, 347.

South-eastern Region: Uitenhage Div., banks of Zwartkop and Sunday Rivers, *Ecklon and Zeyher*, 460. Eland's River, *Florence Paterson*, 932. Uitenhage, *Harvey*. Between Melk and Gamtoos Rivers, *Burchell*, 4797. Komgha Div., Kei River, *Flanagan*, 430. Kaffraria, *Cooper*, 410. Queenstown Div., Gwatyn, Junction Farm, *Galpin*, 8110. Kentani Div., Qolora Valley, *Pegler*, 1297. Griqualand East Div., near Clydesdale, banks of Umzomkulu, *Tyson*, 2090.

var. longa, Glover; legume up to 14 cm. long, 1 cm. broad.

South-eastern Region: Umtata, *Convent of the Holy Cross*, 233. King Williamstown, *T. R. Sim*, 2137.

var. tomentosa, Glover; pinnae up to 20 jugate, young stems, leaflets, peduncles and calyces tomentose; inflorescence densely panicled. Plate XVIII, fig. 11.

South-eastern Region: valleys, Kentani, *Pegler*, 49. Komgha, grassy hills, *Flanagan*, 302. *Schlechter*, 6169. Natal, Maritzberg, *Schlechter*, 3286. Near Durban, *Medley Wood*, 7188, 12377. Near Pinetown, *Medley Wood*, 9267, 9532. Inanda, *Medley Wood*, 1021.

Kalahari Region: Transvaal, Klerksdorp to Wolmaranstad, *Burtt-Davy*, 1534. Barberton, *Thorncroft*, 666. *Bolus*, 7757. Barberton Div., Kaap River Valley, *Galpin*, 564.

var. transvaalensis. Glover; pinnae up to 14 jugate; rachis 14 cm. long, calyx pubescent.

Kalahari Region: Transvaal, common in bush Mooi River to Salt Pan, *Roe*, 37. Reitfontein, *Leendertz*, 844. Irene, *F. A. Rogers*, 11411. Pretoria, *Leendertz*, 49. *Transvaal Government Herbarium*, 10955. *Transvaal Museum Herbarium*, 302, 53. Wonderboompoort, *Rehmann*, 4603. Gonubi River, *Schlechter*, 1381. Rustenberg, *Transvaal Museum Herbarium*, 9719, 6991. Potgietersrust, *Leendertz*, 1138. Warm Baths, *Leendertz*, 1196.

This species is popularly known as "Katdoorn" (Sim's Forest Flora, p. 210).

5. A. eriadenia, Benth., Hook. Lond. Journ. v. 98.

Kalahari Region: Transvaal, Crocodile River and Magaliesberg, *Burke*. Potgietersrust, *F. A. Rogers*. Rustenberg, *Olive Nation*, 218. Houtbosch, *Rehmann*, 6274.

6. A. ataxacantha, DC., Prod. II. 459. Plate XVIII, fig. 3.

South-eastern Region: Between Umtata and Port St John, *Bolus*, 8900. Natal, Hlabeni, *J. Wylie* (*Natal Government Herbarium*, 10038). Umvoti Div., Ehlanzeni, *E. Doidge* (*Transvaal Government Herbarium*, 10466, 10465, 10471, 10469, 10470).

Kalahari Region: Transvaal, Haenertsberg, near Zaederberg's Farm, *Burtt-Davy*, 5187, 1268. Barberton, *Transvaal Government Herbarium*, 2506. Barberton Div., Kaap River Valley, *Galpin*, 564a. Krokodilpoort, *Transvaal Museum Herbarium*, 13842. Waterval Onder, *Transvaal Museum Herbarium*, 6734. Steynsdorp, Komati River, *Transvaal Government Herbarium*, 14. Swazieland, near 'Mbabane, *Bolus*, 11864. Forbes' Reef, *Burtt-Davy*, 2730.

7. A. Kraussiana, Meisn., Lond. Journ. II. 103. Wood's Natal Plants, t. 245. Plate XVIII, fig. 8.

South-eastern Region: Natal, Shafton, Howick, *Mrs Hutton*, 106. Inanda, *Medley Wood*, 461. Near Durban, *Medley Wood*, 265, 6413, 1488. Port Natal, *Krauss*, 198. *Gueinzius*, *Cooper*, 1259. Mozambique, Lourenço Marques, *Schlechter*, 11584.

8. A. pennata, Willd., Sp. Pl. IV. 1090. Wood's Natal Plants, t. 244. Plate XVIII, fig. 5.

South-eastern Region: Natal, Umvoti Div., Ehlanzeni, *E. Doidge* (*Transvaal Government Herbarium*, 10476, 10474). Hills above Weenen, *Medley Wood*, 4469.

It is doubtful whether the South African A. pennata is the true A. pennata, Willd., an Indian species. The matter requires further investigation.

9. A. detinens, Burch., Trav. I. 310. Sim's Forest Flora of Cape Colony, t. 59. Plate XVIII, figs. 2, 7.

Western Region: Damaraland, Great Karasberg, *H. H. W. Pearson*, 8316.

Upper Region: Victoria West, Zand Valley, *Burchell*, 1628.

Kalahari Region: Bechuanaland, Litakun, *Burchell*, 2266, 2402. Kuruman, *Marloth*, 955. Griqualand West, *Burchell*, 1708. Transvaal, Magaliesberg, *Burke,* 570. Waterberg Div., Naboomspruit, *Transvaal Government Herbarium,* 10480. From Christiania to Fourteen Streams, *Burtt-Davy,* 15686. Bloemhof, *Transvaal Government Herbarium,* 1041. Transvaal, *Grenfells,* 5. Warm Baths, *Leendertz,* 2388.

This is popularly known as the " haakedoorn " or " Zwarthaak " on account of the dark brown recurved spines.

10. A. spirocarpoides, Engl., Bot. Jahrb. x. p. 23. Plate XIX, fig. 16.

South-eastern Region: Natal, Umvoti Div., Ehlanzeni, *E. Doidge* (*Transvaal Government Herbarium,* 10462).

Kalahari Region: Barkly West, *Albany Museum,* 649. Kimberley, *Marloth,* 839. Windsorton, *Marloth.* Bechuanaland, Litakun, *Burtt-Davy,* 13897. Transvaal, Waterberg Div., Naboomspruit, *Transvaal Government Herbarium,* 10479, 10491, 1134. Blauwberg, *Transvaal Government Herbarium,* 1688. Springbok Flats, *Burtt-Davy,* 4070. Withak Mountains, south of Boshoff, *Burtt-Davy,* 12403. Bloemhof Div., Cawood's Hope, *Burtt-Davy,* 12959.

11. A. haematoxylon, Willd., Enum., 1056. Plate XIX, fig. 24.

Kalahari Region: Bechuanaland, near Kuruman, *Burchell,* 2449. Hills near Kuruman, *Marloth,* 1056. Griqualand West, Asbestos Mountains, *Burchell,* 1685. Klaarwater, *Burchell,* 1900. Between Klaarwater and Wittewater, *Burchell,* 1964. Near Hopetown, *Dr Muskett* (Bolus Herbarium, 6269).

12. A. giraffae, Willd., Enum., 1054. Sim's Forest Flora of Cape Colony, t. 58. Plate XVIII, fig. 1.

Kalahari Region: Griquatown, Klaarwater, *Burchell,* 1952. Griqualand West, hills and flats, *Mrs Barber,* 8; *T. R. Sim.* Bechuanaland, between Mokala-tree Station and Olive-tree Station, *Burchell,* 2300. Between Terminalia Station and Hot Station, *Burchell,* 2402. Mochudi, plains, *Galpin,* 7010. Mahalapye, *Burtt-Davy,* 1375. Transvaal, Potgietersrust, *Burtt-Davy,* 2300. Pretoria Div., Wonderboom, *Transvaal Museum Herbarium,* 12364. Schweizer Reneke to Wolmaranstad, *Burtt-Davy,* 1685, 1660.

13. A. robusta, Burch., Trav. II. 442. Plate XIX, fig. 22.

Kalahari Region: Bechuanaland, Litakun, *Burchell,* 2265. Transvaal, Magaliesberg, *Burke,* 344. Rhinoster Kop, *Burke.* Waterberg Div., Naboomspruit, *Transvaal Government Herbarium,* 10482. Rustenberg, *Transvaal Government Herbarium,* 1043. Pretoria, *Transvaal Government Herbarium,* 1039. *Transvaal Museum Herbarium,* 218, 467. Vryberg Div., Hassfortt, *Burtt-Davy,* 11181. Orange River Colony, *Transvaal Government Herbarium,* 3812.

14. A. clavigera, E. Mey., Comm. Pl. Afr. Austr. 168. Plate XIX, fig. 13.

South-western Region: Natal, near Durban, *Drège. Gerrard,*

1703. Avoc, *Natal Government Herbarium*, 12966. Umvoti Div., Muden, *E. Doidge* (*Transvaal Government Herbarium*, 10473). Ehlanzeni, *E. Doidge* (*Transvaal Government Herbarium*, 10472).

15. A. lasiopetala, Oliv., Flor. Trop. Afr. II. p. 346. Plate XIX, fig. 23.

South-eastern Region: Natal, Umgeni Valley, *Medley Wood*. Near Ladysmith, *Transvaal Government Herbarium*, 7698, 8442. Colenso, *L. Bolus* (*Bolus Herbarium*, 13738). Zululand, Qudeni Forest, *G. W. Davis*, 100.

16. A. glandulifera, Schinz., Mém. Herb. Boiss. No. I. p. 111. Plate XVIII, fig. 9.

Kalahari Region: Transvaal, Waterberg Div., *Transvaal Government Herbarium*, 2249 a. Barberton Div., Singerton near Hector Spruit, *Burtt-Davy*, 8002. Bushweld between Elandsriver and Klippan, *Rehmann*, 5030. Swazieland, Bremersdorp, *Transvaal Government Herbarium*, 2492.

17. A. hebeclada, DC., Cat. Hort. Monsp. 73. Plate XIX, figs. 19, 20.

Kalahari Region: Bechuanaland, Kuruman Station, *Burchell*, 2185. Litakun, *Burchell*, 2267. Bloemfontein, *Burchell*, 2138. Lobatsi, *F. A. Rogers*, 6208. Griqualand West, *Marloth*, 956. Kenilworth near Kimberley, *Galpin*, 5747. Transvaal, Naboomspruit, *Transvaal Government Herbarium*, 10485, 10488. Pretoria, Wonderboom Poort, *Transvaal Government Herbarium*, 9935. From Wolmaranstad to Bloemhof, *Burtt-Davy*, 1527.

18. A. Benthami, Rochbr., Tox. Afr. II. Plate XIX, fig. 15.

South-eastern Region: Port Natal, *Krauss*, 69. *Gerrard*, 1701. Near Stanger, *Medley Wood*, 4011. Lindleyville, *Medley Wood*, 1801. Inanda, *Medley Wood*, 1536. Umvoti Div., Ehlanzeni, *E. Doidge* (*Transvaal Government Herbarium*, 10467).

Kalahari Region: Transvaal, Potgietersrust, *Transvaal Museum Herbarium*, 5906. Rustenberg, Groenkloof, *Transvaal Museum Herbarium*, 10294. Pretoria, Wonderboom, *Transvaal Museum Herbarium*, 439, 263. *Burtt-Davy*, 2664. *Leendertz*, 439. *Galpin*, 6976. Waterberg Div., Naboomspruit, *Transvaal Government Herbarium*, 10483. Magaliesberg, *Burke*, 270. Springbok Flats, *Burtt-Davy*, 4072.

Bentham in his Monograph of the Mimosae (*Trans. Linn. Soc.* XXX.) regards this species as A. arabica, Willd, var. Kraussiana, but I think it sufficiently distinct to be upheld as a species.

19. A. Gerrardi, Benth., Trans. Linn. Soc. XXX, 508. Plate XIX, fig. 17.

South-eastern Region: Natal, *Gerrard*, 1702. Near Verulam, *Medley Wood*, 3133. St Michael, Campbellton, *Rudatis*, 2121, 2053.

Kalahari Region: Transvaal, Waterberg Div., Naboomspruit, *Transvaal Government Herbarium*, 10486, 10489, 2502. Near Potgietersrust, Pruizen, *Transvaal Government Herbarium*, 9800.

Potgietersrust, *Transvaal Museum Herbarium*, 6554. Pretoria, *Transvaal Museum Herbarium*, 13857.

20. A. Davyi, N. E. Brown, Kew Bull. 1908, 161.

Kalahari Region: Transvaal, Houtbosch, *Rehmann*, 6276. Woodbush, village and hill, *Burtt-Davy*, 5132.

21. A. hirtella, E. Mey., Comm. Pl. Afr. 167. Plate XIX, fig. 21.

South-eastern Region: Natal, between Omcomas and Omblas, *Drège*. Inanda, *Medley Wood*, 730. Winkle Spruit, *Medley Wood*, 12014. *Natal Government Herbarium*, 12910. Near Durban, *Transvaal Government Herbarium*, 6553. Zululand, Qudeni Forest, *Davis*, 97.

The plant figured by T. R. Sim (Forest Flora of Cape Colony, t. 59) is not the true A. hirtella, E. Mey. It seems to be rather A. lasiopetala, Oliv. or an allied species.

22. A. xanthophlaea, Benth., *Trans. Linn. Soc.* XXXVII. 511.

South-eastern Region: 18 miles from Lourenço Marques, plains near Umbeluzi River, *Galpin*, 7889.

Kalahari Region: Transvaal, swamps, Komatipoort, *Burtt-Davy*, 2467, 365. *Orange*, 14, *Grenfells*, Barberton, *Natal Government Herbarium*, 12886, 1144. *Transvaal Government Herbarium*, 2490.

23. A. natalitia, E. Mey., Comm. Pl. Afr. Austr. 167. Plate XIX, fig. 18.

South-eastern Region: Port Natal, *Drège, Gueinzius, Krauss*, 66. *Gerrard*, 1705, 1704. Umvoti Div., Muden, *E. Doidge* (*Transvaal Government Herbarium*, 10468). Ehlanzeni, *E. Doidge* (*Transvaal Government Herbarium*, 10464, 10463, 10475). Near Ladysmith, *Medley Wood*, 5628, 3527. Queenstown, *Baur*. Albany Div., Fish River, *Schlechter*, 6107.

Kalahari Region: Transvaal, Fish River, *Schlechter*, 1382. Crocodile River, *Schlechter*, 3985. Nylstroom, *G. van Dam*. Barberton, *J. Thorncroft*, 61. Rooiplaat, *Leendertz*, 779. Pretoria, *Burtt-Davy*, 4009. Groenkloof, *Transvaal Government Herbarium*, 2468.

24. A. Karroo, Hayne, Argneigew, X. t. 33. Sim's Forest Flora of Cape Colony, t. 61. Jacq. Hort. Schoenbr. III. 75, t. 393. Burch. Trav. I. 189. Plate XVIII, fig. 10.

Plukenet's type of Mimosa madraspatana, upon which Linnaeus partly founded his Mimosa horrida (*Acacia horrida*, Willd.), is a form of the Indian species, A. eburnea, Willd. It has therefore been necessary to find another name for the South African plant, and A. Karroo, Hayne, the next available name, has been reinstated.

Western Region: Namaqualand, two miles south of Tweefontein, *H. H. W. Pearson*, 3456.

South-eastern Region: Fields by the Zwartkop River and hills at Adow, *Ecklon and Zeyher*, 605. Redhouse near Port Elizabeth, *Florence Paterson,* 426. Komgha Div., grassy hills near Kei River Mouth, *Flanagan,* 610.

Karroo Region: Common along water courses in the Karroo, *L. Bolus.* Rivers and mountain sides near Graaff Reinet, *Bolus,* 374.

Kalahari Region: Griqualand West, at Klaarwater, *Burchell,* 1953. Banks of Vaal River, near Barkly West, *Marloth,* 808. Transvaal, Fountains near Pretoria, *Leendertz,* 543. *Transvaal Museum Herbarium,* 8424. Waterkloof Rust, *M. Collins,* 7044. Vereeniging, *Transvaal Museum Herbarium,* 10831. Potchefstroom, *Transvaal Museum Herbarium,* 10049. Zeerust, *Transvaal Museum Herbarium,* 11423. Naboomspruit, *Transvaal Government Herbarium,* 10478, 10484.

This is popularly known as the "Karroo-thorn," "doorn-boom" or "Wittedoorn."

## IMPERFECTLY KNOWN AND DOUBTFUL SPECIES.

A. ferox, Benth., Hook. Lond. Journ. v. 97.

On careful examination of the type specimen of this species in the Kew Herbarium, it was found to be composed of two branchlets, one branchlet being A. detinens, Burch., and the other A. Burkei, Benth. This confusion existed in both the Hooker and Bentham Herbaria. The species A. ferox, Benth. can therefore no longer stand.

A. heteracantha, Burch., Trav. I. 389.

The type specimen of this species consists of a flowering branchlet without fruit. Flowering branchlets of A. spirocarpoides, Engl. seem to me to be identical with those of A. heteracantha, Burch., but as Burchell's type has no fruit and as he in his notes describes the legume as "linear," I hesitate to unite these two species.

A. Litakunensis, Burch., Trav. II. 452.

The type specimen of this species consists of several very young twigs without flower or fruit. It is therefore impossible to tell what this species is. Bentham (*Trans. Linn. Soc.* XXX. tab. 70) figures a legume of A. Litakunensis, Burch., which is spirally twisted and very like that of A. spirocarpoides. This is not in the Kew Herbarium, but may yet be traced among the collections of fruits in the Kew Museums.

A. Rehmanniana, Schinz, Bull. Herb. Boiss. VI. 525.

Kalahari Region: Transvaal, Streydpoort, Makapansberg, *Rehmann,* 5517.

This species, of which I have no specimen, is near A. lasiopetala, Oliver, but differs in having a larger number of pinnae to the leaf (Schinz, Bull. Herb. Boiss. VI. 525). When this species has been more widely collected it may prove to be a variety of A. lasiopetala, Oliv.

# A NOTE ON THE INFLORESCENCE AND FLOWER OF GNETUM[1]

By H. H. W. PEARSON

Most botanists who have studied any member of the Gnetales will agree that the morphology of the flower is "none too clear.[2]" The least obscure of the forms of flower found in the group is the male flower of Welwitschia, though even here there is much difference of opinion as to the interpretation of structural details[3]. In spite of these, this flower is generally regarded as a reduced "Proanthostrobilus" and is considered to be the nearest existing representative of the primitive flower of the group[4]. The female flower in each of the three genera is derived from it by the abortion of the stamens and by the introduction of changes in the floral envelopes which have been the subject of much discussion. It has also given rise to the male flowers of Ephedra and Gnetum[5] by the complete abortion of the ovule, the abortion or more or less complete fusion of the staminal filaments and a measure of reduction in the floral envelopes. These views may be perfectly correct, but no one denies that they rest upon very meagre evidence. They cannot at present be strongly insisted upon without some risk of forcing wrong interpretations and false homologies.

If the three genera were closely related this risk would be small. Their relationships are probably as obscure now as they have been at any time within the last decade and proof that they are of near affinity is lacking. According to a recent authority[6] the common characters which unite them in a single group are "the compound strobili (both staminate and ovulate) resembling inflorescences in which the simple and axillary strobili resemble flowers, the conspicuous micropylar tube, the opposite leaves, the dicotyledonous embryo, the true vessels and the absence of resin-canals." On the other hand, the differences which are ascertained are very considerable. Apart from the interpretation of the inflorescence and flower which is perhaps open to question, a comparison of the gametophyte stages does not at first sight suggest any close degree of affinity. It is true that some authors consider that "too much weight has been attached to 'embryological' dissimilarities[1]," but the weight which they can bear can hardly be estimated until they are better understood. Great as are the apparent differences between them it is probable that the type found in Welwitschia is not distantly related to that of Gnetum, and possible that both may be derived in a simple and direct manner from that of Ephedra. On the other hand it is not impossible that these gametophytic structures indicate that Gnetum and Welwitschia have diverged widely from the line represented by Ephedra. In either case the reproductive organs of the sporophyte of the three genera may be directly and not distantly related. But until clear evidence upon these questions becomes available, the conclusion that the alliance between the three genera is close enough to warrant the derivation of the floral structures of Gnetum and Ephedra from a type still preserved in Welwitschia is hardly more than an assumption.

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[1] *Percy Sladen Memorial Expeditions in South-West Africa, Report, No.* 75 (in part).

[2] Scott, 1909, II. p. 538.

[3] Lignier and Tison, 1912, pp. 58–90.

[4] But see Von Wettstein, 1907, p. 28.

[5] Hooker, 1863, p. 24. Arber and Parkin, 1908, p. 502, Fig. 3, iv, v.

[6] Coulter and Chamberlain, 1910, p. 363.

Gnetum itself presents special difficulties. In Ephedra and Welwitschia the bracts and flowers are strictly decussate in arrangement and, in Welwitschia at least, the products of successive nodes appear in a well marked acropetal order. In Gnetum the flowers stand in densely crowded whorls or, occasionally, they and their subtending bracts are disposed in a long and continuous spiral (Fig. 1); otherwise the cupules are clearly the result of the concrescence of decussate pairs of bracts. Further peculiarities are seen in the very common reduction of the female flowers which, in most species, stand at the top of each node of the male inflorescence; and the basipetal development of a succession of male flowers. Also the products of successive nodes do not arise (in *G. Gnemon* and probably other species) in acropetal order (Fig. 2 A).

These considerations make it the more necessary that the importance of certain characters of the Gnetum flower and inflorescence which do not appear to support the current views of their origin, should not be underrated.

The material available for examination represents *G. Gnemon*, *G. africanum*, and *G. scandens* fairly abundantly, and includes a few specimens of undetermined species from Singapore and Java and male inflorescences of *G. Buchholzianum*. In addition to the acknowledgements already made[2], I am indebted for supplies to the Acting Director of the Buitenzorg Gardens; Major Gage, I.M.S., F.L.S., Superintendent of the Royal Botanic Gardens, Calcutta; Mr I. H. Burkill, F.L.S., Director of the Royal Botanic Gardens, Singapore; Mr G. H. Cave, Curator of the Lloyd Botanic Gardens, Darjeeling, and Mr C. C. Calder, F.L.S., Curator of the Herbarium, Royal Botanic Gardens, Calcutta. The material was collected with a view to the study of the later stages of the embryo sac. Unfortunately it includes no very young stages of the female inflorescence—of which little is known[1]—and only one young male inflorescence (Fig. 2 A).

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[1] Arber and Parkin, *l.c.* p. 506.

[2] Pearson, 1912, 1915.

Three types of flower occur in Gnetum; these are (1) the male, (2) the complete female (fertile, with 3, sometimes 4[2] envelopes), (3) the incomplete female (infertile, with 2 envelopes). The incomplete female apparently never occurs except in association with male flowers. The male flowers are unaccompanied by female flowers in *G. africanum*[3], *G. Buchholzianum* and the upper nodes of the inflorescence of *G. scandens.* In all species studied, the complete female flower occurs, one ring at each node[4], in an inflorescence in which no males are present. In *G. Gnemon* one or more complete female flowers are commonly found, replacing incomplete females, in the male inflorescence, particularly in its later stages.

The male flower consists of an axis bearing one (*G. Rumphianum*[5], probably *G. latifolium*[5] and *G. verrucosum*[5] and rarely *G. Gnemon*[6]), two (most species), or rarely four[6] (*G. Gnemon*), anthers, surrounded completely when young, at the base only when mature, by a utricle-like membranous envelope (Figs. 3, 6, 11). The envelope commonly contains two vascular bundles lying in the antero-posterior plane; sometimes as many as five bundles are present[7]. In *G. Rumphianum* the envelope has no vascular tissue[7]—as in all species of Ephedra, except *E. fragilis* in which one (rarely two) minute bundle enters the posterior half[8].

The male flowers arise in crowded basipetal parastichies[9]; when an upper ring of incomplete female flowers is present the uppermost males stand in the spaces between their lower boundaries. Filamentous hairs are formed on any part of the meristem not occupied by flowers; they are particularly abundant below the ring of female flowers and below the last formed male flowers. There is reason to believe that a fresh growth of hairs occurs after the fall of the withered male flowers; frequently they are produced in great profusion and are more or less united into bundles for some distance above their point of origin.

The number of parastichies and of flowers in each parastichy varies considerably even within the same species. Karsten[1] found, almost without exception, in *G. Gnemon*, 11 parastichies each containing 5—7 flowers, i.e. about 66 flowers at each node. The material now under examination yields the following figures:

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[1] Cf. Karsten, 1893.

[2] Pearson, 1915.

[3] Exceptionally, female flowers are present. Pearson, 1912.

[4] Two rings in *G. latifolium* (Karsten, *l.c.* Taf. x, fig. 53).

[5] Karsten, 1893, p. 341.

[6] Pearson, 1915.

[7] Strasburger, 1872, p. 156; Karsten, *l.c.* p. 346.

[8] Thoday and Berridge, 1912, p. 973. The exceptional occurrence of a bundle in the perianth of another species is recorded by Strasburger (1872, p. 137).

[9] Karsten, *l.c.* Taf. x; Coulter and Chamberlain, 1910, figs. 426, 427; Pearson, 1912, Pl. LX, fig. 2.

| Species | Origin | Parastichies | Flowers in Parastichy. | Flowers at node |
|---|---|---|---|---|
| *G. Gnemon* | Singapore | 7 | 7 | 49 |
| do. | Ceylon | 9—15 | 6 | → 90 |
| do. | Buitenzorg | 10 | 5—6 | 50 |
| *G. scandens* | Tenasserim | 16—32 | 4—6 | 60 → |
| *G. africanum* | Angola | 9 | 3—5 | 27 → |
| *G. Buchholzianum* | Cameroons | 12 | 3—4 | 40 |

The number of flowers on a single inflorescence is therefore very large; in *G. scandens*, for example, the number of nodes is rarely less than 14 and frequently as many as 17; the number of male flowers formed on the inflorescence about 1 inch long may therefore exceed 3000.

The antherophore remains enclosed in the utricular envelope until the pollen grains are almost mature; it then appears to elongate very rapidly, pushing the anthers through the aperture at the summit of the envelope and over the edge of the subtending cupule. In this process, as in the last stage of the elongation of the androecium of Welwitschia[2], the starch which is present in abundance in the cells of the young antherophore becomes quite exhausted. Also the cells which in the early stages are approximately isodiametric, in the fully extruded antherophore are much elongated in the direction of the axis of the whole structure, being 8—10 times as long as broad. When once the antherophore is fully extended the anthers dehisce or are so near the point of dehiscence that a very slight pressure is sufficient to cause them to open (Fig. 3 A). Sooner or later after dehiscence, the whole flower, with the envelope, falls away (Fig. 4). The bared surface is now densely covered by hairs and, except for the trunks of the vascular traces there is no sign that it has ever borne male flowers (Fig. 4). The incomplete female flowers (*G. Gnemon*) appear to reach maturity before the anthers of the oldest male flowers dehisce, after which they shew no further increase in size. The embryo sac sometimes develops as far as the stage at which the sac nuclei become grouped for fusion[3]. In the inflorescence from which all or nearly all the male flowers have fallen, the embryo sac of ovules with only two envelopes, in all cases examined, had disappeared and was represented only by a hole in the nucellus. Complete female flowers which frequently occur among them[3], if pollinated, appear to be fertilised and to undergo normal development.

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[1] Karsten, *l.c.* p. 343.

[2] Cf. Church, 1914, p. 143.

[3] Cf. Pearson, 1915.

The origin of complete female flowers on the male spikes needs further investigation. In a collection of material of *G. Gnemon* sent from Ceylon by the late Dr R. H. Lock there are many male spikes from which some or all the male flowers have fallen. In these spikes a proportion of the female flowers are almost invariably complete—i.e. they possess the middle envelope which is absent from the incomplete flower. Only one of them has been proved to be pollinated[1], but there is no reason to doubt that they are functionally as well as structurally complete. There has been much difference of statement as to the order in which the three envelopes of the female flower appear[2]. According to the latest pronouncement[3], the middle envelope normally arises after the inner one, though it is not clear whether this statement is founded upon direct observation or is merely an interpretation of the results of earlier authors. If however it is correct, it is not impossible that, as the male inflorescence loses its male flowers, some of the incomplete female flowers become complete by the formation of the hitherto missing envelope[4]. If so the inflorescence may be an example of the dichogamous separation of the sexes. It should however be noted that in its later female condition, such an inflorescence would still differ from the normal female by the presence of vascular traces indicating the former presence of male flowers[5] (Fig. 4).

Nothing is definitely known as to the function of the incomplete female flowers. Karsten[6] suggests that they are concerned in pollination but the evidence is incomplete. While this is quite possible in the case of *G. Gnemon* and many other species in which these flowers are by comparison large and conspicuous, it is highly improbable in *G. scandens* in which they are very small (Fig. 5). A considerable amount of material of this species has been examined but no case has been seen in which the incomplete female flower is visible at the surface[7] of the inflorescence. So far as is known it never advances beyond the stage figured and no trace of an embryo sac has been seen in it. As is pointed out above, the upper nodes of the inflorescence in this species usually bear male flowers only.

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[1] Pearson, 1915.

[2] Lotsy, 1899, pp. 63, 64.

[3] Coulter and Chamberlain, 1910, p. 376.

[4] Cf. Strasburger, 1872, p. 102. Karsten (1893, p. 347) and Lotsy (1899, p. 88) state that a rudimentary median envelope is present in the incomplete female flower. Their observations are not confirmed by Mrs Thoday (1911, p. 1123).

[5] A male inflorescence of *G. Gnemon* which has lost all its male flowers is also easily distinguished from the normal female inflorescence by the very dense growth of hairs below the remaining ring of female flowers. In Lotsy's figures 2 and 3 (1899) the "yellow dots" which represent the "tips of the paraphysal hairs" (*l.c.* p. 110) cover as wide a band as that occupied by the hairs in the old male inflorescence in the Ceylon material referred to. In this material the normal female inflorescence never bears so many hairs and in this respect more nearly resembles Lotsy's figures 4—6.

[6] *L.c.* p. 349.

[7] Cf. also *G. funiculare* and *G. latifolium* (Karsten, *l.c.* figs. 49, 53).

The male inflorescence of *G. scandens* is probably correctly regarded as a stage in the reduction from the type of *G. Gnemon* to those of *G. africanum*, in which female flowers are very rarely present[1], and *G. Buchholzianum* in which female flowers are not known to occur[1]. Since complete and fertile female flowers frequently occur in the male inflorescence of *G. Gnemon*, in which they occupy positions otherwise filled by incomplete female flowers, the latter may be regarded as derived from the former by partial arrest; in the absence of any direct evidence to the contrary, it is hardly possible to take any other view[2]. If this be so, the pure male inflorescence of *G. Buchholzianum* is the final result of the reduction of the female flowers of a functionally bisexual inflorescence; and intermediate stages in this reduction are preserved in *G. Gnemon*, *G. scandens* and *G. africanum*.

In *G. Gnemon* (Fig. 2) and in *G. funiculare*[3] and probably in all species in which female flowers are present in the male inflorescence, the female flowers precede the male in ontogeny at each node. Assuming the existence of a functionally bisexual inflorescence in which all the female flowers were potentially fertile, an arrest of the nodal meristem immediately after the organisation of the female flowers would give the pure female inflorescence which apparently occurs in all species. If the male inflorescence has been derived by the partial, and finally the complete, arrest of the female flowers, it almost follows that the female inflorescence owes its origin to a similar arrest of the male flowers of a functionally bisexual inflorescence. It may be that stages shewing a preliminary reduction in the organisation of the male flowers will yet be described.

The large number of male flowers formed in basipetal succession at each node of the male inflorescence is probably to be regarded as a derived character. Its biological result is comparable to that produced by a profuse branching of the inflorescence as a whole. The necessity for the production of male flowers in greater profusion may well have arisen as a consequence of the introduction of the unisexual inflorescence. The basipetal development of lateral members appears to be confined to axes of limited growth[4]. Well known cases are those of the soral axis of ferns of the "Gradatae" section[5] and of many floral axes bearing numerous stamens[6]. There is very little information regarding the growth of the axis of the Gnetum inflorescence, but the fact that all the nodes are probably established before the development of the flowers commences (cf. Fig. 2) leads to the conclusion that here also the basipetal succession of the male flowers is associated with limited apical growth of the axis which bears them.

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[1] Pearson, 1912, p. 608.

[2] But see Von Wettstein, 1907.

[3] Karsten, 1893, Taf. VIII, fig. 11.

[4] Goebel, 1900, I, 41.

[5] Bower, 1908.

[6] Goebel, 1905, II, p. 542, fig. 369.

It may then be considered as probable that the functionally bisexual inflorescence from which the unisexual forms now found are derived, bore few male flowers at each node, perhaps only a single ring. In this connection the course of the vascular trunks which supply the flowers in *G. Gnemon* (Fig. 6) may be suggestive. The main trunk on separating from the leaf-trace passes upwards towards the female flower and gives off a branch opposite the oldest male flower. From this latter another branch passes downwards supplying successively the younger male flowers. This structure is at least reconcilable with the view that the two main branches, viz. those which supply the female flowers and the ring of male flowers immediately beneath them, represent a relatively primitive vascular system from which the smaller branches supplying the lower male flowers are of later origin. In *G. scandens* (Fig. 5 A) the course of the vascular traces supplying the flowers is less constant[1]; the form shewn in the figure is frequently seen. It perhaps reflects the decreased importance of the female flower compared with that of *G. Gnemon.*

Each node is ensheathed in a short cupule consisting of a concrescent pair[2] of reduced leaves[3]. In the male inflorescence, the cupule is sometimes irregularly split by the pressure of the developing flowers (Fig. 7). While the cupules themselves may possibly appear in acropetal succession, this order of development does not extend to the products of successive axillary meristematic rings in the stage represented by the youngest male inflorescence available (Fig. 2). Here the median nodes are clearly in advance of those above and below them. In all the stages of the female inflorescence examined, as in the later stages of the male, the flowers at successive nodes appear to be approximately equal in development; at least, no node is distinctly in advance of any other. In Ephedra on the other hand the primordia of the youngest pair of male flowers are fairly advanced in development before the succeeding pair of bracts are yet visible on the surface of the vegetative cone of the axis[4]. The last stage of the inflorescence of an undetermined species of Gnetum from Singapore shews a peculiarity which is probably closely connected with the non-acropetal succession of the nodes. Mr I. H. Burkill writes regarding it: "After flowering the upper part of the spike (☿) breaks off and falls to the ground, leaving the flowers of the lowest axils." A branch sent by Mr Burkill bears two peduncles from which all the flower-bearing nodes have fallen, and three with one, two with two and one with three nodal rings of flowers still in position. The complete inflorescence bears 14 nodes.

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[1] Cf. Pearson, 1912, text fig. 2.

[2] Karsten, 1893, p. 340; Pearson, 1912, p. 607.

[3] In this respect Gnetum resembles Ephedra (Stapf, 1889, pp. 20, 23) and the male cone of Welwitschia (cf. Hooker, 1863, p. 21). With regard to the female cone of Welwitschia (Hooker, *l.c.* p. 24, Pl. VIII, fig. 29), Church (1914, p. 118) is in error in stating that neither the "sterile scales at the base of the (ovulate) cone, nor the fertile bracts are connate below." In every cone examined by the present writer, the condition is exactly as described and figured by Hooker (*l.c.*). In this connection, reference may be made to a feature of the ovulate cone which does not appear to have been noticed previously. It is well known that the lower 6—8 pairs of bracts of the ovulate cone are sterile (Pearson, 1909, p. 333; Church, *l.c.*). It now appears that between the seed-bearing portion of the cone and the succession of empty scales below, there are from 2—4 pairs bearing in their axils female flowers which do not develop beyond the point at which they are little more than just visible to the naked eye. (Cf. Goebel, 1905, II, p. 511.)

[4] Strasburger, 1872, p. 132; Taf. XIV, figs. 2, 3.

The frequent occurrence of a terminal flower, on the female as well as on the male inflorescence, is well known[1]. Karsten[2] states that he is unable to confirm Strasburger's observation, but the writer finds that terminal flowers are exceedingly common on male and female inflorescences of *G. Gnemon* obtained from Ceylon. When the tip of the spike is barren it does not possess the form nor the parts of a vegetative bud and it is clearly incapable of further development[3]. The apical meristem of the axis[4] is therefore able to produce either a barren tip with no potentiality of further elongation or a female flower. It is a reasonable inference from this fact that the barren tip is an aborted female flower. Its form sometimes suggests that it consists of the terminal "segment" of the axis and a cupule completely concrescent with it[5]. That such a concrescence may occur is shewn in Fig. 8 A, C. In this specimen of the male inflorescence of *G. Gnemon*, the meristematic ring behaves normally on one side of the lowest node (Fig. 8). On the opposite side it disappears owing to the complete concrescence of the cupule with the axis. Followed round the node, the meristematic ring enters a canal (Fig. 8 B, C) which becomes gradually smaller until the fusion is complete (Fig. 8 A).

In Ephedra the apex of the female spike is usually aborted or represented by an arrested projection composed of a few cells (*E. distachya*[6]). According to Strasburger[7] the terminal ovule of *E. altissima* is produced "unmittelbar aus dem Scheitel der primären Achselknospe"; more recently it has been regarded as the result of the fusion of the primordia of two lateral ovules[8]. In Welwitschia the apex of the axis of the female cone frequently contains one or more macrospores[9]. This fact, regarded by recent writers as an unimportant "abnormality"[1] has been confirmed by Church[2] who remarks that an archesporium "in the apical growing point of the cone was found in all specimens examined and may be taken as the rule." In the case figured[2], the apex of the axis containing a macrospore bears a striking resemblance to a female flower in an early stage of development[3].

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[1] Strasburger, 72, p. 158.

[2] Karsten, 1893, p. 342.

[3] Pearson, 1912, text fig. 6.

[4] It is unfortunate that no one has yet been able to describe an inflorescence in which the development of nodes and internodes is incomplete.

[5] This suggestion was first made by Mr A. St Clair Caporn, a student in this laboratory, as the result of a study of the inflorescence of an undetermined species of Gnetum, sent by Mr Burkill from Singapore.

[6] Thoday and Berridge, 1912, p. 954.

[7] Strasburger, *l.c.* p. 87.

[8] Thoday and Berridge, 1912, p. 962.

[9] Pearson, 1909, p. 333.

It appears then that the cone-axes of Welwitschia and Gnetum, if not also of Ephedra, may produce sporogenous tissue and perhaps are to be regarded as potential nucelli reduced to the condition of vegetative axes. But if so their manner of growth is quite different. In Welwitschia there is a gradual apical growth with the regular production of crowded lateral outgrowths in acropetal succession; in Gnetum the number of nodes is very much smaller, crowded or distant, and, so far as can be judged from the material available, the stages of development at successive nodes are very much closer than in Welwitschia and not acropetal. When once the nodes and internodes are laid down in the primordium, the further growth seems to be entirely intercalary. The meaning of this peculiarity will not be satisfactorily explained until there has been an opportunity of examining very much younger inflorescences than have yet been available.

While the number of nodes appears to be more or less a specific character[4], there are occasionally considerable variations from the normal. In *G. Buchholzianum*, for example, an inflorescence with only two nodes has been described[5]. Owing to the early organisation of the nodes of the inflorescence, and the presence of the normal number of normal flowers at each node, it is improbable that the production of only two nodes is due to starvation or to other unfavourable conditions. It has been suggested that the primitive type from which both the existing male and female inflorescences are derived had only one node at which were produced probably only a single ring of male flowers and a terminal group (including a terminal flower) of female flowers[1,2]. In this connection Miss Berridge's discovery of small vascular complexes arising from the main vascular system between the outer and median envelopes in the complete female flower of *G. Gnemon*[2] is of interest. If these structures are vestiges of the traces which formerly supplied a ring of male flowers, as Miss Berridge supposes, they indicate that a grouping of flowers similar to that suggested above has been in existence. The identification of such a bisexual "flower" with the supposed primitive form of inflorescence would establish homologies between (*a*) the complete female flower and a uninodal inflorescence, (*b*) the cupule of the inflorescence and the outermost envelope of the complete female flower. However improbable such homologies may at first sight appear, they do not entirely lack support. In addition to the inference drawn from the frequent presence of a terminal female flower, we have the fact recorded by Mrs Thoday[3] that the vascular supply of the female flower of Gnetum is very similar to that of the whole cone of *Cycadeoidea Wielandii* and, it may be added, to that of a lateral inflorescence of Gnetum itself. A fact of even more significance is that, in a case in which the main axis of the inflorescence was injured, a lateral inflorescence replaced a female flower (Fig. 7). The injury to the main axis had taken place early in its development for the slightly concave surface of the wound was protected by two or three layers of suberised tissue, some of which was secondary. The secondary inflorescence was truly lateral in position, and its vascular supply passed out from the bundle system of the primary inflorescence in the same manner as the bundle supply to the female flower. The node from which the secondary inflorescence arises had previously borne several series of male flowers, as is indicated by the broken trunks of the traces which supplied them. The female flowers which fill up the ring on which the secondary inflorescence stands are incomplete. Although the evidence of earlier stages is wanting, the conclusion that the primordium which normally develops into a female flower may, under certain circumstances, produce a normal cone, appears to be abundantly justified.

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[1] Sykes, 1910, p. 207; Lignier and Tison, 1912, p. 165.

[2] Church, 1914, p. 124, Pl. 10, fig. 5.

[3] Attention may be drawn to a misapprehension of the argument based by the writer on the discovery of sporogenous cells in the cone-axis. Miss Sykes (Mrs Thoday) states (1910, p. 206) that "the remarkable discovery of megaspores in the axis of the female cone has however led Pearson to consider the possibility of regarding it as morphologically different from the male cone." A reference to the original description and discussion (Pearson, 1909, p. 334) shews that this remarkable structure was used only in support of the generally accepted view that the ovule of Welwitschia is cauline and that the axis of the female cone is broadly speaking homologous with a nucellus—a nucellus which has acquired the characters of a vegetative axis. Further, it is definitely stated (Pearson, *l.c.* p. 335) that the absence of these sporogenous cells "from the axis of the male cone, if confirmed, is not remarkable..., for the ovule of the male flower apparently never produces sporogenous cells." The suggestion that the male and female cones are not strictly homologous had no reference to the structure of the cone-axes (Pearson, *l.c.* pp. 337, 338).

[4] Pearson, 1912, p. 614.

[5] Pearson, *l.c.*

In both male and female inflorescences in *G. scandens* and *G. Gnemon* the normal nodal disposition of cupule and floral ring is frequently replaced partially or entirely by a continuous spiral. In the case figured—a male inflorescence of *G. Gnemon* (Ceylon)—the three lower whorls are tilted but remain distinct, while, in the upper part, the floriferous band with its subtending cupule traces a right-handed spiral (Fig. 1). Other cases have been seen in the male inflorescences of the same species from Buitenzorg. In a female inflorescence of *G. scandens* from Darjeeling there were two distinct whorls at the bottom, and, above these, 13 continuous turns of a right-handed spiral.

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[1] Pearson, *l.c.*

[2] Berridge, 1912.

[3] Thoday, 1911, p. 1130.

A second specimen (female) from the same material shewed three distinct whorls below and above them six complete turns of a *left*-handed spiral. In other cases there are distinct whorls at base and apex separated by a spiral. In these, the tissues of the axis shew no indication of torsion. This peculiar development is probably due to the conditions under which the young inflorescence develops. All the cupules and nodal rings are laid down and the uppermost flowers derived from the latter are fairly advanced (Fig. 2) before the inflorescence (when axillary) emerges from the subtending bract. A slight change in the normal pressure conditions may therefore be presumed to exercise a powerful influence upon the adult form of the inflorescence. But until more information regarding the early stages of the inflorescence is available the phenomenon cannot be fully explained.

Apart from the occasional development of such a spiral arrangement of lateral members, the whorl of two members is established in Gnetum as in Ephedra and Welwitschia. The only exceptions in the group are found in the disposition of the flowers of Gnetum and of the stamens of Welwitschia[1]. According to Church[1] there is no evidence that the whorl of six stamens in Welwitschia is derived from a more primitive pair, and the same is true for Gnetum.

On the facts and inferences which have now been stated is based the suggestion that the primitive inflorescence of Gnetum consisted of a short axis bearing a terminal female flower or a group of female flowers of which one was terminal, surrounded at a lower level by a ring of male flowers; that from this structure the existing multinodal inflorescence has arisen by the addition of new parts to the axis through the retention of vegetative characters by the axis of the terminal flower.

The lateral female flower is regarded as a secondary axis bearing a terminal nucellus ("organised directly from the tip of the bud axis[2]") and two or three envelopes. Of these the innermost is undoubtedly an integument; the outermost, it has been suggested above, is formed of two concrescent bracts homologous with those which form the cupule. The fact that the middle envelope contains vascular tissue would suggest that it is allied in origin to the outermost rather than to the innermost envelope, but the evidence is not conclusive. There is however no clear reason why either should be regarded as homologous with the angiosperm perianth[3].

The male flower has received less attention than the female. It is a widely accepted view that it is a "proanthostrobilus." Comparatively minor differences of opinion prevail as to the precise morphology of the antherophore and of the envelope of Ephedra or Gnetum. The antherophore is (1) a solitary stamen[1]; (2) a monadelphous group of two stamens[2]; (3) a prolongation of the floral axis bearing one or two sessile anthers[3]. The envelope is (1) a perianth, calyx or perigone[4]; (2) a vaginula[5]; (3) a pair of fused bracteoles[6] or bracts; (4) a membranous basilar sheath[7]. If the antherophore is a foliar structure, i.e. a staminal filament or two or more concrescent filaments, the interpretation of the morphology of the envelope becomes of first-rate importance, for upon it rests the responsibility of raising the whole structure to the rank of a flower.

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[1] Church, 1914, p. 133.

[2] Coulter and Chamberlain, 1901, p. 122.

[3] Cf. Coulter and Chamberlain, 1910, p. 363.

Hooker[8], impressed by the structure of the pseudobisexual flower of Welwitschia, suggested that the male flower of Ephedra—and, by inference, that of Gnetum—was derived from an ancestral type now represented by Welwitschia, by the total abòrtion of the ovule and its accessory structures. This idea seems to have prevailed more or less indefinitely until, within recent years, it has become more generally accepted[9]. In their discussion, Arber and Parkin made a strong point of the generally received opinion that the six stamens of Welwitschia, like the two of Gnetum, arise from the opposite primordia[10]. But this view of the origin of the Welwitschia androecium is discarded by Church[11], who shews reason for regarding it as "a single whorl of six equal members." This fact does not of course invalidate the comparison, but it robs it of much of its force. It may fairly be said that at the moment there is no conclusive evidence to support the conception that the male flower of Gnetum is derived by reduction from a bisexual strobilus[12].

The fact that so many writers have regarded the male flower as a strobilus, although some have adopted interpretations of its parts which are not readily compatible with this view, at least indicates that no other explanation obviously offers itself. That it is in some degree a natural view to take of the adult flower no one will deny. But those who have advocated it have not sufficiently considered the earlier stages of development nor have they satisfactorily explained certain apparently discordant facts established by a study of the details of the adult structure.

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[1] Blume, 1834, p. 101; Tulasne, 1858, p. 113; Parlatore, 1868, p. 348; Le Maout and Decaisne, 1868.

[2] Lindley, 1853; Hooker, 1863, p. 23; Eichler, 1863, p. 17; Van Tieghem, 1884; Worsdell, 1901.

[3] Strasburger, 1872, p. 157; Coulter and Chamberlain, 1901, 1910.

[4] Blume, 1834, p. 102; Endlicher, 1847; Lindley, 1853; Tulasne, 1858, p. 112; Hooker, 1863, p. 23; Eichler, 1863, p. 16.

[5] Meyer, 1846.

[6] Parlatore, 1868, p. 348; Thibout, 1896; Coulter and Chamberlain, 1910, p. 371.

[7] Le Maout and Decaisne, 1868.

[8] Hooker, 1863, p. 24.

[9] Coulter and Chamberlain, 1901, p. 120; Arber and Parkin, 1908, p. 497; Lotsy, 1911, p. 360.

[10] Arber and Parkin, *l.c.* p. 502, fig. 3 iv, and v.

[11] Church, 1914, p. 133.

[12] Strasburger arrives at the same conclusion for Ephedra, 1872, p. 139.

The antherophore is variously regarded as a cauline or a foliar structure —in the latter case it is comparatively unimportant whether it represents one filament or more. Characters which appear to be pertinent in this connection are: (1) it is entirely intercalary in origin; (2) it is usually traversed by bundles equal in number to the anthers[1], i.e. two; (3) in Ephedra the antherophore is frequently two-lobed and in *E. distachya* the lobes separate near the base[2]; (4) in *E. fragilis* the antherophore exhibits a circinnate vernation[3] and in several species of Ephedra it possesses a broad laminate form[3]. In Ephedra it is therefore probable that the antherophore is composed of sporophylls more or less concrescent[4] and, if this is true for Ephedra, there is little reason to doubt that it is equally true for Gnetum. If so the only structure which can represent the floral axis is the minute pedestal which, in the adult flower, supports the antherophore and the envelope.

The flowers of Gnetum are not clearly axillary if, as is fairly certain, the cupule is composed of two concrescent leaf-structures. To regard them as axillary in position is to assume that the meristematic ring is derived from two opposite axillary primordia. The only evidence by which such a hypothesis can be supported is the fact that solitary and apparently axillary flowers occur in Ephedra and Welwitschia—evidence whose value as applied to Gnetum is very doubtful.

If the envelope is inserted upon the secondary (floral) axis, it may be anticipated that the axis will precede the envelope in ontogeny. If further the envelope consists of two concrescent leaves, some indications of such a structure may be expected. Such indications would be: (1) the two leaves would probably arise simultaneously from opposite primordia—opposite leaves being so regular a character of Gnetum, as of the other members of the group; in this case it is probable that at later stages of growth the envelope will be more or less lobed, the lobes standing vertically over the primordia. Or if (2) the leaves are concrescent from the beginning they may arise as an equal collar, whose insertion will be likely to be in a plane perpendicular to the secondary axis and, at least in the early stages of its growth, the structure as a whole will be radially symmetrical. (3) Vascular bundles will be normally present, probably one along each line corresponding to the midribs of the concrescent leaves; and they will arise by branching from the bundle system of the secondary (floral) axis; if bundles are absent, their absence must be explained by reduction.

The envelope arises as a collar. The upper (anterior) part of it precedes the lower (posterior) in origin and is in advance of it in all the later stages of its growth. Of two opposite primordia there is no sign whatever. When the lower (posterior) edge of the envelope and the anther-primordium are barely evidenced as slight convexities on the surface of the meristem, its upper edge (Fig. 9) is already quite distinct. Many young flowers in longitudinal section have been examined but no exception to this rule has been met with. The lateral parts of the collar are less advanced than the upper edge, more so than the lower (Fig. 10). Both the free edge of the envelope and its apparent insertion on the secondary axis are oblique from beginning to end. A comparison of the three stages of Fig. 10 shews that the short length of axis which in the adult flower (Fig. 5) stands below the origin of the envelope, is formed entirely by intercalary growth; and that the deep fissure which separates the youngest flower from the undifferentiated meristem beneath it, is caused by this intercalary growth and the increase in bulk and surface area of the general meristem, which occur together.

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[1] This is not without exception. More than one case has been seen in which an antherophore bearing two anthers was traversed by three bundles (Fig. 2 B). A case in which four anthers were present has been described (Pearson, 1915) but the bundles were not yet differentiated.

[2] Stapf, 1889, p. 21; Thoday and Berridge, 1912, p. 971.

[3] Thoday and Berridge, *l.c.* p. 970.

[4] *L.c.* p. 974.

The collar grows more quickly than the anther primordia and eventually arches over them and completely encloses them save for a very narrow short slit (Fig. 11). This slit is displaced towards the lower (posterior) side of the flower by the more active growth of the upper part of the envelope; the line of the slit is parallel to a line joining the centres of the two anthers (cf. Fig. 11 C and D). In consequence of the rapid growth of the antherophore, in its later stages, the edges of the envelope are forced apart and split. The splitting in *G. Gnemon* is usually irregular, but frequently into two approximately equal lobes lying in the antero-posterior plane[1] (Fig. 3). This last method of opening is probably simply due to the fact that the main line of splitting is determined by the longer diameter of the two anthers—the back of each anther acting as a blunt cutting edge.

The unequal development of the envelope is well known. Karsten figures a young male flower in which the upper edge is considerably in advance of the lower[2]; he also describes similar relations in *G. funiculare*[3] and figures them in *G. latifolium*[4]. There is no indication that the incomplete female flower exhibits the same tendency to a basipetal succession of its parts in development[5], nor is it clear that it is formed by the same meristem which later produces the males (Fig. 2 B). But the study of earlier stages than are yet available might lead to a contrary conclusion.

From the published figures of Ephedra it appears that the axial portion of the male flower is relatively slightly earlier developed than in Gnetum, and even in its very early stages the envelope either arises from the secondary axis or is concrescent with it. Nevertheless the upper (anterior) part of the envelope soon appears to be in advance of the lower. This is particularly shewn in Strasburger's figures of *E. campylopoda*[1] and by Land for *E. trifurca*[2]. Traces of this early inequality in development seem to be retained in later stages[3]. In the absence of further information it is quite possible that these relations are inconstant and unimportant. If however they represent the normal condition there is suggested the possibility that the male flower of Ephedra may be formed by a basipetally developing meristem as in Gnetum and that the latter genus differs from Ephedra in the circumnodal extent of the meristem and in its long continued activity. And there arises the further question whether the envelope originates from the secondary axis or is merely concrescent with it.

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[1] Cf. Lotsy, 1911, fig. 213, 2, 4.

[2] Karsten, 1893, Taf. VIII, fig. 12.

[3] *L.c.* p. 344.

[4] *L.c.* Taf. VIII, figs. 8–10.

[5] *L.c.* Taf. VIII, figs. 11, 16.

It can hardly be doubted that the male flowers of Gnetum and Ephedra are homologous structures and that one of them is more primitive than the other. All the probabilities are in favour of regarding Ephedra as representing the earlier type. This receives strong support from the large number of anthers and the characters of the antherophore itself to which reference has already been made (p. 164). If so, in view of the absence of vascular tissue from the envelopes of Ephedra[4] and from that of at least one species of Gnetum, the normal presence of bundles in the envelope of Gnetum may well be a secondary character whose appearance is in response to physiological needs, and, therefore, without morphological significance. In the absence of direct evidence, this view is more probable than that which regards the envelope of Ephedra as a reduced form of a vascularised envelope such as that of Gnetum.

It is easy, and perhaps not unusual, to attach too great importance to the details of the vascular system. But it is worthy of notice that the two bundles which normally supply the envelope of Gnetum lying in the antero-posterior plane, separate from that which supplies the two branches in the antherophore at a very low level. Frequently the separation occurs in the tissue of the primary axis (Fig. 12); when it takes place higher up it still necessarily occurs in that part of the secondary axis which is intercalated below the level at which the concrescence of the envelope with antherophore ceases.

If the characters described above do not shew that the envelope is not composed of concrescent leaves, at least they cannot be disregarded by those who would make it a perianth.

The question of the place of origin of the envelope has yet to be considered. Does it arise from the secondary (floral) axis? The envelope has now been shewn to be very distinctly basipetal (with regard to the main axis) in the order of its development. Its development is therefore very clearly controlled by the meristem of the main axis, not by that of the secondary axis. Further it seems that the secondary axis has not attained to separate existence before at least the upper edge of the envelope is established. It is true that this upper edge has not been recognised earlier than the stage of Fig. 9 A, in which the primordium of the *anthers* is just visible as a slight convexity. But the whole structure is still a part of the general meristem, and it is at least an open question whether the secondary axis as such is yet in existence. It is of course possible that both the relatively late appearance of the axis and the basipetal development of the collar are consequences of the crowding of the products of the nodal meristem. At present however this can be no more than an assumption—an assumption which involves important conclusions regarding the morphological value of the structures formed.

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[1] Strasburger, 1872, p. 133, Taf. XIV, figs. 2, 3.

[2] Land, 1904, Pl. I, fig. 3.

[3] *L.c.* figs. 1, 4; Thoday and Berridge, 1912, text fig. XX, 1.

[4] Except in *E. fragilis*, etc. (see p. 154).

If on the other hand the envelope is not composed of concrescent leaves and if it arises directly from the primary axis, as is not impossible on the evidence available, there are no longer any clear reasons for regarding the whole structure, consisting of the envelope, the antherophore, and the anthers as a male flower. All that can be recognised is a microsporophyll or a bundle of two or more monadelphous microsporophylls, surrounded by a "basilar sheath." In this case the axis of the primitive form of inflorescence suggested above (p. 162), bears stamens not male flowers. That such a view presents difficulties which are at the moment insurmountable is evident. Not the least of these is that of accounting for the basilar sheath if it be not a pair of concrescent leaves. It may however be pointed out that it is not the only structure in the genus of which a satisfactory explanation is not yet forthcoming. An example is seen in the fleshy "basilar sheath" or "nodal cushion[1]" which envelopes the young female flower and surrounds its lower half in the older stages in *G. africanum*. The origin of this structure is unknown; vascular bundles enter its base. No one will attempt to derive this sheath from concrescent leaves; and yet otherwise its nature is obscure.

There is no reason to suppose that, in a morphological sense, there is anything in common between the envelope in Gnetum and the "integumental" covering of the microsporangium of *Lepidostrobus Oldhamius* (? *Lepidocarpon Lomaxi*)[2]. Its existence may however be usefully remembered until the nature of the Gnetum envelope is more clearly established.

To formulate a new hypothesis of the morphology of the Gnetum flower and inflorescence is not one of the objects of this paper. It is rather an attempt to shew that the evidence at present available is not entirely favourable to the only hypothesis which holds the field and is insufficient to serve as a basis for any alternative view. Owing to the difficulty of obtaining the necessary material, no single species has yet been adequately studied, and of the majority of the species we know nothing more than the few macroscopic features on which their specific rank is established. The morphology of the structures concerned cannot be regarded as satisfactorily established until a wider and more intense study of the genus than has yet been made, has furnished a new body of fact.

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[1] Thoday, 1911, p. 1102, Pl. LXXXVII, fig. 14; text-figs. 3, 13 A and C.

[2] Scott, 1901, p. 312 sqq., Pl. 41, fig. 7.

## SUMMARY.

1. Considerable differences occur within the same species in the numbers of male flowers produced in basipetal succession at each node of the inflorescence. In *G. scandens* the number of male flowers in a single inflorescence may be as many as 3000.

2. The elongation of the antherophore which immediately precedes the dehiscence of the anthers is presumably very rapid. As in Welwitschia, intermediate stages between those in which the anthers are still concealed in the envelope, and the antherophore fully extended, are not seen. In the last stage of growth of the antherophore its cells become much elongated and lose their starch.

3. The male inflorescence of *G. Gnemon* usually bears one or more complete female flowers. These are in some material more abundant in old inflorescences from which some or all the male flowers have fallen.

4. In *G. scandens* the incomplete female flowers are very small and, so far as known, are always concealed from view by the male flowers. The upper nodes in this species usually produce no female flowers.

5. It is suggested that *G. scandens* shews a stage in the reduction of the female flowers of the male inflorescence which, when carried further, results in the pure male inflorescence of *G. africanum* and *G. Buchholzianum.*

6. Since the incomplete female flowers must be regarded as derived by partial arrest from complete and potentially functional flowers, the former existence of a normally bisexual inflorescence must be assumed.

7. From such a bisexual inflorescence, the pure female inflorescence was probably derived by the arrest of the nodal meristem by which the later formed male flowers are produced.

8. It is suggested that the long continued activity of the meristem which forms the male flowers is a derived character—probably to be correlated with the separation of the sexes in unisexual inflorescences. It is therefore probable that in more primitive forms a smaller number of male flowers was formed at each node—perhaps only a single ring.

9. In *G. Gnemon* the successive nodal meristems are not developed in acropetal order. In early stages those near the middle of the axis are usually in advance of those nearer the base and apex.

10. The common occurrence of a terminal female flower, described by Strasburger, is confirmed. It confirms the conclusion drawn from the form of the otherwise barren tip, the non-acropetal order of succession of the nodes, and the basipetal development of the lateral male flowers, that the growth of the main axis is limited.

11. Since the barren tip of the axis may be replaced by a female flower, they are regarded as homologous.

12. A suggestion that the primitive inflorescence consisted of an axis bearing a cupule, a ring of male flowers, and a terminal female flower—or a group of which one was terminal—is renewed and supported.

13. Evidence for regarding the female flower as homologous with a uninodal inflorescence, and its lowest envelope with the cupule, is stated.

14. The male flowers are not regarded as being axillary to the cupule.

15. The envelope of the male flower arises as an oblique collar, its upper edge being always in advance in development.

16. Usually (in *G. Gnemon*) the edge of the envelope does not shew two lobes in the antero-posterior plane which might be expected if it represented two concrescent leaves. When such lobes do appear in later stages they are probably due to mechanical causes.

17. The vascular supply to the envelope frequently leaves the trunk which supplies the antherophore while still within the tissues of the main axis.

18. The evidence that the envelope arises from the secondary (floral) axis and not direct from the main axis, is inconclusive

19. In view of these facts it is concluded that the evidence in support of the current view that the male flower is a reduced "anthostrobilus" is insufficient.

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## EXPLANATION OF PLATES

C = cupule.
M = nodal meristem producing male flowers.
Tr. = bundle in envelope of male flower.
m.t. = main trunk of bundle system of antherophore.

Figs. 5 A and B = *G. scandens*; the remainder = *G. Gnemon*.

Fig. 1. An inflorescence shewing both whorled and spiral arrangements of cupule and flowers × 3.

Fig. 2 A. Long. sect. of youngest male inflorescence seen × 20.

x = female flower enlarged in 2 B.
Br = bract.

2 B. The flower x in 2 A × 150.

$C_1$ = subtending cupule.
$C_2$ = cupule of node next above.
E = outer envelope.

Fig. 3. (Drawn from specimens cleared in potash. Cf. Church, 1915.)

A. A male flower with fully extended antherophore and dehiscing anthers × 24.

B and C. Bases of adult male flowers shewing form of edge of envelope × 150. In B one bundle of the antherophore branches near the base; at a higher level the branch ($B_1$) anastomoses with the other bundle.

in = inner limit of thickness of envelope.

Fig. 4. Long. section through node of male inflorescence from which all the older (upper) male flowers have fallen. The section passes between the insertions of two incomplete female flowers.

ft = traces which supplied the fallen male flowers × 20.

Fig. 5 A. Long. section through node shewing one female and four male flowers and the main trunks of the vascular system × 21.

5 B. The female flower of 5 A × 100.

Fig. 6. Long. section through node shewing one female and four male flowers and the main trunks of the vascular system × 21.

Fig. 7. An inflorescence in which the main axis has lost by injury all but one node which bears six incomplete female flowers and a lateral mixed inflorescence replacing a seventh female flower × 4.

S = broken surface of main axis.

Fig. 8 A—C. Three of a series of long. sections of the lower part of a male inflorescence. h = hairs.

A. The cupule of the lowest node is free on the left; completely concrescent on the right.

B. Leaf tip still concrescent with cupule above; a canal containing nodal meristem (M) between the cupule and the main axis.

C. Leaf tip free from cupule above, still concrescent with upper edge of nodal meristem. The rest of the meristem is therefore still enclosed in the canal. In the next section of the series, the cupule is completely free and the nodal meristem exposed on the right as on the left.

Fig. 9 A—C. Median longitudinal sections (*parallel* to axis of inflorescence) through successively older stages of young male flowers.

U = upper, L = lower edges of envelope; an = anther primordium; ♂ = male flower next above.

A × 300; B, C × 150.

Fig. 10 A, B. Long. sections (*transverse* to the axis of the inflorescence) through two stages of the young male flower. The younger (A) is slightly more advanced than that of Fig. 9 C. U = upper edge of envelope; an = anther primordium.

A × 158; B × 150.

Fig. 11 A—D. The first and second (A, B) and two later (C, D) successive (slightly oblique) transverse sections of a series of the young male flower in which the growth of the edge of the envelope is complete. The median vertical plane of the flower is indicated by the arrow. The greater development of the upper edge (U) of the envelope is very marked. The anthers are seen in C and D × 80.

Fig. 12. Long. sect., parallel to the axis of the inflorescence through the base of a male flower, shewing the origin of the vascular supply to the envelope × 21.

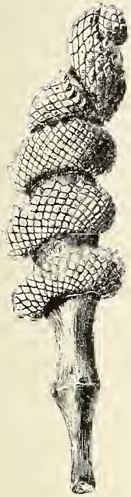


Fig. 1

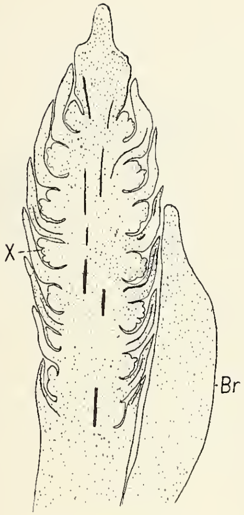


Fig. 2 A

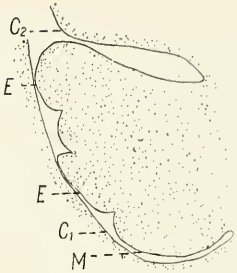


Fig. 2 B

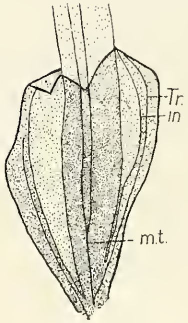


Fig. 3 C

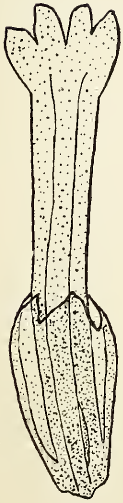


Fig. 3 A

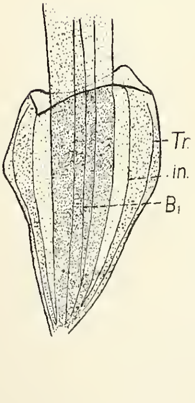


Fig. 3 B

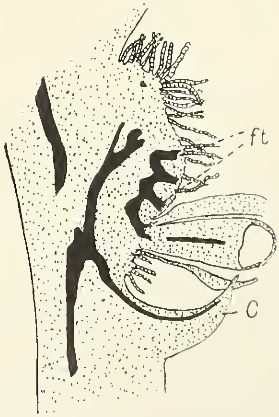


Fig. 4

*Fig.* 1, *G. L. Birbel, del.*
*Figs.* 2—4, *H. H. W. P., del.*

Gnetum

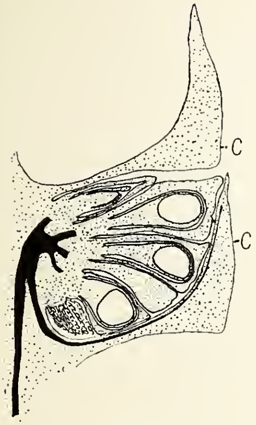


Fig. 5 A

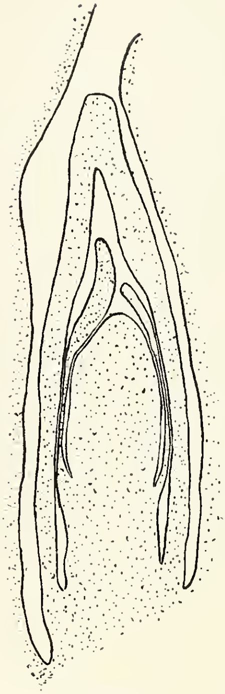


Fig. 5 B

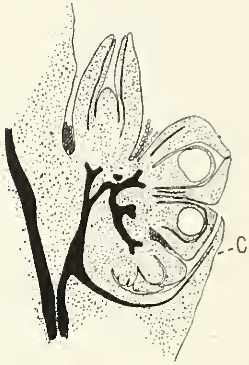
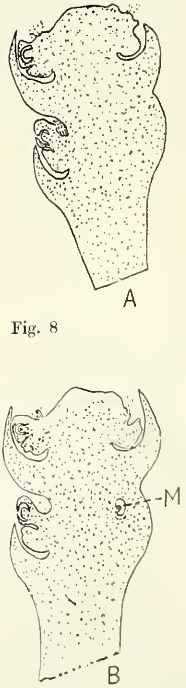


Fig. 6



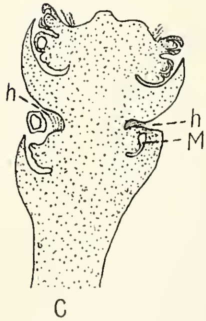


Fig. 8

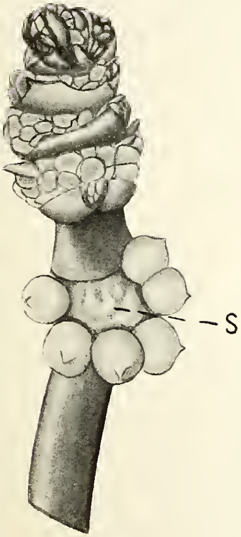


Fig. 7

***Fig.* 7, *M. W. Glover, del.***
***Figs.* 5, 6, 8, *H. H. W. P., del.***

Gnetum

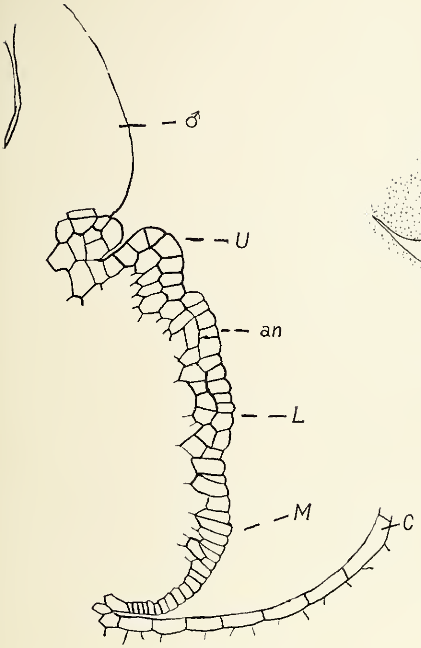


**Fig. 9 A**

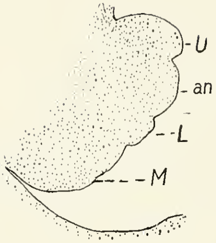


**Fig. 9 B**

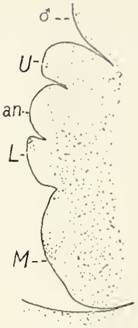


**Fig. 9 C**

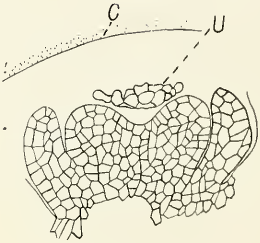


**Fig. 10 B**

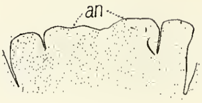


**Fig. 10 A**

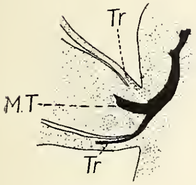


**Fig. 12**

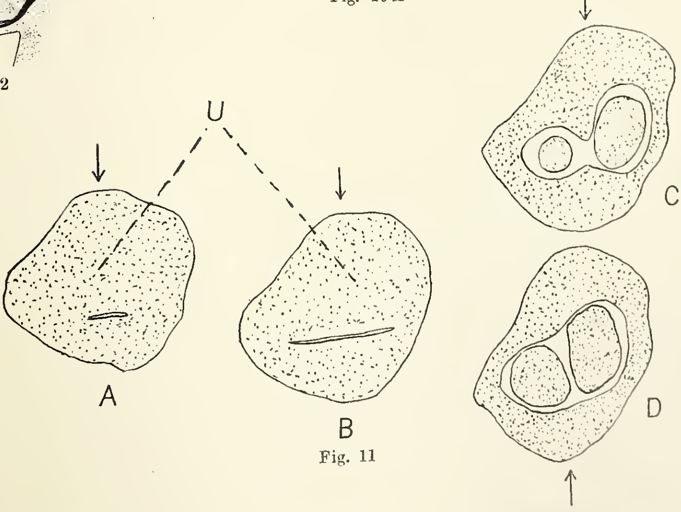


**Fig. 11**

*H. H. W. P., del*

Gnetum

# KEY TO THE FLORA OF THE CAPE PENINSULA

By F. and L. BOLUS

(*Continued from page* 125)

## LINACEAE.

LINUM, Linn.

### LINUM.

Leaves usually 4nate, about 3 ls. wide. *quadrifolium*, Linn.
Leaves usually not 4nate, < 3 ls. wide.
  Sepals long acuminate; styles usually connate to the middle. *Africanum*, Linn.
  Sepals acute; styles usually free to the base or nearly so.
    Leaves crowded, usually alternate. *thesioides*, Benth.
    Leaves remote, usually opposite. *Thunbergii*, E. and Z.

## ZYGOPHYLLACEAE.

Leaflets in several pairs; fruit spiny. TRIBULUS, Linn.
Leaflets in one pair; fruit not spiny. ZYGOPHYLLUM, Linn.

### TRIBULUS.

*terrestris*, Linn.

### ZYGOPHYLLUM.

Leaves sessile.
  Leaflets linear < 1 l. wide or a few of the lowest a little wider. *spinosum*, Linn.
  Leaflets > 1 l. wide.
    Decumbent; petals whitish or pale yellow with crimson markings from above the middle to the base. *sessilifolium*, Linn.
    Erect; petals usually bright yellow with markings from below the middle to the base.
      Capsule ovate-oblong, 8—10 ls. long; outer sepals setaceously acuminate, 4—5 ls. long. *fulvum*, Linn.
      Capsule globose or subglobose, 3—4 ls. long; outer sepals obtuse or subacute, 2—3 ls. long. *flexuosum*, E. and Z.

Leaves petiolate.

Capsule broadly winged, 1 in. or more in diam. *Morgsana*, Linn.

Capsule narrowly winged, 2—5 ls. in diam.

Ultimate branches becoming rigid and spiny; leaflets 2—3 ls. long. *incrustatum*, E. Mey.

Ultimate branches not as above; leaflets > 4 ls. long.

Calyx glabrous; capsules subglobose.

Stipules minute, caducous; leaflets usually < 7 ls. long. *Lichtensteinianum*, Cham. and Schl.

Stipules about 1 l. long; leaflets usually 1 in. or more long. *foetidum*, Schrad. and Wendl.

## GERANIACEAE

Carpels adhering to a beak-like receptacle and separating at maturity, 1-ovuled.

Corolla regular; nectary not decurrent on the pedicel.

Stipules pungent; peduncles 1-fld.; stamens 15. Monsonia, Linn.

Stipules not pungent; peduncles > 1-fld.; stamens < 15.

Stamens 10, all fertile. Geranium, Linn.

Stamens 10, 5 fertile. Erodium, Lher.

Corolla irregular; nectary decurrent on the pedicel. Pelargonium, Lher.

Carpels not as above, usually > 1-ovuled. Oxalis, Linn.

### Monsonia

*ovata*, Cav.

### Geranium

Leaf-segments linear or oblong.

Sepals pubescent with silvery appressed hairs. *incanum*, Linn.

Sepals pubescent with spreading glandular hairs. *dissectum*, Linn.

Leaf-segments ovate or deltoid. *ornithopodum*, E. and Z.

### Erodium

Leaves cordate-ovate, not cut to the mid-rib. *malachoides*, Willd.

Leaves oblong, cut to the mid-rib into distinct leaflets. *moschatum*, Willd.

### Pelargonium

Roots tuberous, usually covered with rigid tunics.

Stems not appearing above ground; leaves usually < 3 in. wide.

Petals 5.

Leaves usually pinnately compound, the leaflets subopposite or alternate, often petiolulate.

Leaflets entire or rarely with one or two divisions.
  Leaflets lanceolate or ovate, ± acute; petals with a deeply-coloured spot in the middle. *astragalifolium*, Pers.
  Leaflets broadly ovate, obtuse; petals with deeply-coloured veins. *pinnatum*, Linn.
Leaflets cut up into numerous narrow segments. *rapaceum*, Jacq.
Leaves not compound, usually deeply cut or cut and entire on the same plant.
  Entire leaves not present, leaf-segments narrow-linear, often 1 in. long. *barbatum*, Jacq.
  Entire leaves usually present, leaf-segments linear or ovate.
    Leaves hirsute with long white hairs *hirsutum*, Ait. and var. *melananthum*, Harv.
    Leaves glabrescent or shortly pubescent.
      Leaves ovate, oblong or lanceolate, tapering at both ends.
        Umbel 3—9-fld. *longifolium*, Jacq.
        Umbel 10—20-fld. *angustifolium*, Thunb.
      Leaves subrotund, often 3-lobed. *revolutum*, Andr.
Petals 2. *marginatum*, R. Knuth.
Stems appearing above ground, prostrate or scrambling; leaves usually > 3 ins. wide.
  Stems long and scrambling, much swollen at the nodes; leaves nearly glabrous. *gibbosum*, Willd.
  Stems not as above; leaves usually densely pubescent.
    Leaves cordate at base, 3-lobed, 3-partite or 3-foliolate. *lobatum*, Willd.
    Leaves pinnately decompound.
      Ultimate leaf-segments ½ l. wide or less. *flavum*, Ait.
      Ultimate leaf-segments > ½ l. wide. *triste*, Ait.
Roots not tuberous.
  Stems thick, older parts bearing the persistent petioles with adnate stipules; leaf-segments very fine and hairy. *hirtum*, Jacq.
  Stems and leaves not as above.
    Nerves on the sepals dark and conspicuous.
      Perennial; upper petals much longer than the lower.
        Leaves canescent and silky on both sides. *candicans*, Spreng.
        Leaves glabrous or pubescent, not silky. *myrrhifolium*, Ait. and vars.
      Annual; lower petals nearly as long as upper petals. *senecioides*, Lher.
    Nerves on the sepals not dark and conspicuous.
      Flowers < 4 ls. long; petals usually very little longer than the sepals.

Leaves roundish; nectary subinfundibuliform; sepals ovate-lanceolate, acuminate. Frequenting damp places. *grossularioides*, Ait.

Leaves oblong; nectary cylindrical; sepals oblong, acute. Frequenting dry sandy places. *chamaedryfolium*, Jacq.

Flowers > 4 ls. long; petals distinctly longer than the sepals.

Two upper petals narrower than the lower. *zonale*, Willd.

Two upper petals broader than the lower.

Herbaceous or scarcely suffruticose, slender; leaves often zoned; petioles twice as long as the blade or more.

Leaves glabrescent, glaucous. *saniculifolium*, Willd.

Leaves pubescent, not glaucous.

Stipules cordate-ovate acute. *alchemilloides*, Willd.

Stipules lanceolate, rigidly ciliate. *tabulare*, Lher.

Shrubby or suffruticose, not slender; leaves never zoned, petioles usually < twice as long as blade.

Leaves not cordate at base, petiole shorter than blade.

Leaves ovate-oblong, rarely > 1 in. long. *betulinum*, Ait.

Leaves as broad as or broader than long, usually > 2 in. long. *angulosum*, Ait.

Leaves ± cordate at base, petiole as long as or longer than blade.

Leaves cup-shaped; upper petals usually 1 in. or more long. *cucullatum*, Ait.

Leaves not cup-shaped; upper petals usually < 9 ls. long.

Larger leaves lobed beyond the middle. *capitatum*, Ait.

Larger leaves not lobed beyond the middle. *vitifolium*, Ait.

### OXALIS

Flowers solitary.

Leaves unifoliolate. *monophylla*, Linn.

Leaves 3—19-foliolate.

Leaflets 3.

Upper leaves crowded, mostly on long petioles.

Leaflets linear or linear-cuneate.

Petals with a darker margin on the outside.

Stem usually with undeveloped leaves (scales) below; petioles more than 2 ls. long; leaflets more than $\frac{1}{2}$ l. wide; stem-leaves not subsessile. *versicolor*, Linn.

Stem usually leafy throughout; petioles less than 2 ls. long; leaflets $\frac{1}{2}$ l. or less wide; stem-leaves subsessile in fascicles. *tenuifolia*, Jacq.

Petals without a darker margin.

Leaflets 3—4 ls. long; inner stamens toothed.

Under surface of leaflets and the sepals glabrous or subglabrous. *glabra*, Thunb.

Under surface of leaflets and the sepals more or less densely pilose; leaflets mostly recurved. *falcata*, Sond.

Leaflets 6—12 ls. long; inner stamens with a dorsal swelling near the base. *polyphylla*, Jacq.

Leaflets not as above.

Leaflets linear-oblong, oblong, oval or obovate.

Hairs not gland-tipped.

Stem hardly or not appearing above the ground; inner stamens toothless. *minuta*, Thunb.

Stem well exserted; inner stamens toothed. *glabra*, Thunb.

Hairs gland-tipped.

Petals with a darker margin on the outside. *multicaulis*, E. and Z.

Petals without a darker margin on the outside. *glabra*, Thunb.

Leaflets not as above.

Leaflets subrotund, obtuse or scarcely retuse; stem not or hardly appearing above ground.

Flowers not yellow.

Plant not glabrous.

With gland-tipped hairs. Petioles, peduncles and calyx glandularly downy. Leaflets sometimes minutely ciliate with gland-tipped hairs; calyx 1 l. long; bulb angular. *punctata*, Linn. f.

Without gland-tipped hairs.

Corolla funnel-shaped.

Leaflets remotely ciliate with long coarse hairs or bristles, often denticulate, distinctly petiolulate, up to about 5 ls. long and wide. Bulb about 4 ls. long with thin and soft scales. *denticulata*, Wolley-Dod.

Leaflets not as above, up to more than 1 inch long and wide. Bulb 6—12 ls. long, scales thick and rigid. *variabilis*, Lindl.

Corolla salver-shaped. *purpurea*, Thunb.

Plant glabrous, leaflets netted-veined and whitish above, pitted or minutely punctate and veiny below, thin; sepals acute. *commutata*, Sond.

Flowers yellow or yellowish.

Bulb scales not gummy; sepals lanceolate, acuminate, up to 4 ls. long; tube of corolla narrow. *Eckloniana,* Presl.

Bulb scales gummy.

Peduncles usually shorter than the leaves; sepals ovate-lanceolate; bulb up to 1 in. or more long and nearly as wide. *balsamifera,* E. Mey.

Peduncles usually longer than the leaves; sepals oblong, subobtuse; bulb shorter and narrower. *luteola,* Jacq

Leaflets not as above.

Leaflets (the medial or all) obcordate.

Stem not or hardly appearing above ground.

Hairs on the petioles and peduncles reflexed; bulb angular. *obtusa,* Jacq.

Hairs on the petioles and peduncles not reflexed; bulb not angular. *lanata,* Linn. f.

Stem well exserted above the ground.

Water plant with a floating rosette of leaves. *natans,* Linn. f.

Terrestrial; glabrous. *incarnata,* Linn.

Leaflets deeply bilobed. *bifida,* Thunb.

All the leaves sessile or very shortly petiolate, the upper not crowded. Peduncles axillary.

Leaflets oblong-cuneate, lanceolate or linear-cuneiform. *hirta,* Linn.

Leaflets broadly obovate or subrotund; petioles dilated at base. *brevicaulis,* Sond.

Leaflets 4—19.

Flowers not yellow.

Leaflets oblong or obovate-cuneate, 12—19; corolla white. *tomentosa,* Linn.

Leaflets linear.

Leaflets with two apical calli on the under surface, bulb pale brown. *pentaphylla,* Sims.

Leaflets without apical calli; bulb blackish. *pentaphylloides,* Sond.

Flowers yellow.

Leaflets oblong-linear or linear, 1—3 ls. wide; sepals equal. *flava,* Linn.

Leaflets oblong or obovate with a cartilaginous margin, 4—6 ls. wide; sepals subequal. *lupinifolia,* Jacq.

Flowers umbellate.

Roots bulbous.
  Flowers yellow or yellowish.
    Leaflets pilose or pubescent above and below, hairs shining. *sericea*, Linn. f.
    Leaflets glabrous above, pilose or pubescent below.
      Leaflets obcordate; petioles distinctly compressed. *compressa*, Thunb.
      Leaflets obcordate-bilobed; petioles not distinctly compressed. *cernua*, Thunb.
  Flowers not yellow.
    Stem not appearing above ground; umbel 2—6-fld. *caprina*, Linn.
    Stem well exserted above ground; peduncles lateral; bulb ovate, brown, conspicuously striate. *livida*, Jacq.
Roots not bulbous; flowers yellow, small. *corniculata*, Linn.

## RUTACEAE

Stamens 5,
  Petals naked; disk not closing over the ovary. DIOSMA, Linn.
  Petals bearded in the middle; disk closing over the ovary. MACROSTYLIS, B. and W.
Stamens 10, 5 fertile, 5 ± aborted.
  Petals longitudinally channelled, enfolding the sterile filaments. COLEONEMA, B. and W.
  Petals not as above.
    Anthers with a stalked gland; petals about 6 ls. long. ADENANDRA, Willd.
    Anthers not bearing a gland; petals usually < 4 ls. long.
      Flowers 1—5 on axillary twigs or peduncles. BAROSMA, Willd.
      Flowers in umbellate or capitate clusters at the end of the branches. AGATHOSMA, Willd.

### MACROSTYLIS

*villosa*, Sond.

### DIOSMA

Leaves constantly opposite, rather thick.
  Leaves usually 2 ls. long or more; petals obtuse. *succulenta*, Berg.
  Leaves usually 1 l. long or less; petals acute. *cupressina*, Linn.
Leaves usually alternate. *vulgaris*, Schl.

### COLEONEMA

*album*, B. and W.

### ADENANDRA

Flowers sessile or subsessile, gummy and sticking together.

Leaves 2 ls. long, glands invisible; fls. 3—4 in a head *obtusata,* Sond.
Leaves 4—6 ls. long, glands sometimes apparent; fls. 4—8 in a head. *viscida,* E. and Z.
Flowers stalked, the peduncles rarely exceeding the uppermost leaves.
Glands on the under surface of the leaf in two rows, one on each side of the mid-rib. *biseriata,* Meyer.
Glands scattered.
Leaves glabrous above, ciliate, downy beneath, sometimes eglandular. *ciliata,* Sond.
Leaves not as above.
Peduncles exceeding uppermost leaves, 4—6 ls. long. *brachyphylla,* Schl.
Peduncles about as long as or shorter than the uppermost leaves, usually < 3 ls. long.
Leaf-margins revolute. *uniflora,* Willd.
Leaf-margins flat or thickened.
Petals downy on both sides. *cuspidata,* Mey.
Petals glabrous above.
Petals pink-flushed beneath. *umbellata,* Willd.
Petals deep red all over beneath. *amoena,* B. and W.

## BAROSMA

Peduncles usually < 1 l. long; style villous. *crenulata,* Hook.
Peduncles usually > 2 ls. long; style glabrous.
Petals narrowed to the base, scarcely clawed. *pulchella,* B. and W.
Petals with a slender, claw, 1 l. long. *pulchella,* var. *tabularis,* Dümmer.

## AGATHOSMA

Flowers arranged in involucrated heads, the inner leaves of the involucre coloured. *Hookeri,* Sond.
Flowers not arranged as above.
Sterile filaments like the petals and as long.
Peduncles 4—6 ls. long; blade of sterile filament gradually dilated. *umbellata,* Sond.
Peduncles 1½—2 ls. long; blade of sterile filament suddenly dilated. *stricta,* Wolley-Dod.
Sterile filaments narrower than the petals and shorter.
Leaves ovate or broadly ovate, cuspidate. *imbricata,* Willd.
Leaves not as above.
Leaves not ciliate.
Branches glabrous.
Claws of the petals < ½ as long as limb. *Gillivrayi,* Sond.
Claws of the petals about as long as limb. *glabrata,* B. and W.

Branches pubescent.
  Leaves gibbous on the back below the apex. *multicaulis*, Dümmer.
  Leaves not as above. *capensis*, Dümmer.
Leaves ciliate with rather long white hairs.
  Calyx usually < 1 l. long.
    Ovary pubescent. *cerifolium*, B. and W.
    Ovary glabrous. *muizenbergensis*, Dümmer.
  Calyx 1 l. or more long.
    Leaves obtuse or subobtuse. *rugosa*, Link.
    Leaves acute or acuminate.
      Leaves up to 10 ls. long and 2 ls. broad. *ciliata*, Link.
      Leaves usually up to 4 ls. long and 1 l. broad.
        Leaves incurved at the apex, hairy on the lower surface. *villosa*, Willd.
        Leaves spreading or recurved at the apex, glabrous except on keel margins.
          Calyx-segments acuminate. *ambigua*, Sond.
          Calyx-segments obtuse. *Dodii*, Dümmer.

## AQUIFOLIACEAE

Ilex, Linn.

### Ilex

*capensis*, Sond. and Harv.

## CELASTRACEAE

Leaves alternate.
  Fruit capsular, loculicidally dehiscent.
    Valves of the capsule furnished externally with outgrowths. Pterocelastrus, Meissn.
    Valves of the capsule nude.
      Cells of the ovary 6-ovuled; capsule red, 6—9 ls. long. Putterlickia, Endl.
      Cells of the ovary 2-ovuled; capsule under 4 ls. long. Gymnosporia, W. and A.
  Fruit fleshy, indehiscent.
    Leaves under 1 in. wide; fls. 4-merous; ovules erect. Cassine, Linn.
    Leaves often up to 2 in. wide; fls. 5-merous; ovules pendulous. Maurocenia, Linn.
Leaves opposite.
  Leaves entire.
    Flowers racemose; ovules erect. Lauridia, E. and Z.
    Flowers not racemose; ovules pendulous. Maurocenia, Linn.

Leaves toothed.
  Leaves usually lanceolate, acuminate, yellowish green; fls. 4-merous. HARTOGIA, Thunb.
  Leaves usually obovate or suborbicular, greyish green; fls. 5-merous. CASSINE, Linn.

### GYMNOSPORIA

Branches spinescent.
  Leaves entire, up to 4 ls. broad. *Schlechteri*, Loes.
  Leaves crenulate or serrate, up to 1 in. broad.
    Leaves obovate-oblong, cuneate at base. *buxifolia*, Szysz.
    Leaves (upper) rhomboidal. *rhombifolia*, E. and Z.
Branches not spinescent.
  Leaves acuminate, margin serrate. *acuminata*, Szysz.
  Leaves acute or obtuse, margin entire.
    Leaves oval or suborbicular, veins conspicuous. *lucida*, Loes.
    Leaves not as above.
      Leaves ovate-oblong or oblong. *laurina*, Loes.
      Leaves lanceolate. *angustifolia*, Loes.

### PUTTERLICKIA

*pyracantha*, Loes.

### PTEROCELASTRUS

Leaves obtuse or acute; cyme shortly pedunculate, few-fld. *tricuspidatus*, Sond.
Leaves acuminate; peduncle up to 1 in., many-fld. *rostratus*, Walp.

### CASSINE

Leaves alternate. *maritima*, L. Bolus[1].
Leaves opposite.
  Leaves entire. *Schinziana*, L. Bolus[2].
  Leaves toothed.
    Leaves narrowed towards the base. *capensis*, Linn.
    Leaves subcordate. *barbara*, Linn.

### MAUROCENIA

*frangularia*, Mill.

### LAURIDIA

*reticulata*, E. and Z.

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[1] Described as a species of *Celastrus* by H. Bolus who had not seen the fruit. This was recently collected by A. St C. Caporn near Kalk Bay and is a one-seeded drupe, the seed being erect.

[2] *Maurocenia Schinziana*, Loes., but on account of the erect ovule is rather Cassine.

## RHAMNACEAE

- Calyx glabrous.
  - Flowers in umbellate clusters; fruit juicy. SCUTIA, Comm.
  - Flowers paniculate; fruit dry. NOLTEA, Reichb.
- Calyx pubescent. PHYLICA, Linn.

### SCUTIA

*capensis*, Don.

### PHYLICA

- Leaves stipulate. *stipularis*, Linn.
- Leaves exstipulate.
  - Bracts much longer than the flowers, forming plumes at the ends of the branchlets.
    - Flowers spicate. *plumosa*, Thunb.
    - Flowers capitate.
      - Bracts about ½ l. wide. *capitata*, Thunb.
      - Bracts 1—1½ l. wide. *Dodii*, N. E. Br.
  - Bracts often longer than the flowers but ± leaf-like and not forming plumes.
    - Flowers in dense spikes ½—2 in. in length. *spicata*, Linn. f.
    - Flowers usually in heads rarely elongating into short spikes ½ in. long.
      - Heads 5 ls. or more in diameter.
        - Involucral leaves conspicuously longer than the flowers.
          - Calyx-tube hirsute. *reflexa*, Lam.
          - Calyx-tube glabrous. *callosa*, Thunb.
        - Involucral leaves shorter or scarcely longer than the flowers.
          - Calyx-tube glabrous. *callosa*, Thunb.
          - Calyx-tube hirsute.
            - Hairs on the calyx-tube reversed, petals glabrous. *bicolor*, Linn.
            - Hairs on the calyx-tube not reversed, petals ciliate. *cuspidata*, E. and Z.
      - Heads of fls. < 5 ls. in diameter.
        - Heads stalked; leaves usually > 2 ls. wide. *buxifolia*. Linn.
        - Heads not stalked; leaves usually < 2 ls. wide.
          - Calyx 1½—2 ls. long, the tube pubescent or woolly.
            - Leaves 5—10 ls. long.
              - Hairs on the calyx-tube reversed. *strigulosa*, Sond.
              - Hairs on the calyx-tube not reversed. *eriophoros*, Berg.
            - Leaves 2 ls. long. *selaginoides*, Sond.
          - Calyx 1 l. or less long, the tube glabrous
            - Leaves cordate-lanceolate; calyx-segments lanceolate. *acmaephylla*, E. and Z.

Leaves linear, subulate or lanceolate; calyx-segments ovate.
Heads arranged on subumbellate twigs. *ericoides,* Linn.
Heads arranged on paniculated twigs. *parviflora,* Linn.

### NOLTEA

*africana,* Reichb.

## AMPELIDACEAE

VITIS, Linn.

### VITIS

*capensis,* Thunb.

## SAPINDACEAE

MELIANTHUS, Linn.

### MELIANTHUS

*major,* Linn.

## ANACARDIACEAE

RHUS, Linn.

### RHUS

Leaflets closely whitish tomentose on the lower surface.
Leaflets narrow-linear, about 1 l. wide, margins revolute.
*rosmarinifolia,* Vahl.
Leaflets > 1 l. wide, margins usually flat.
Leaflets sessile, linear-lanceolate. *stenophylla,* E. and Z.
Leaflets petiolulate, lanceolate or elliptic.
Leaflets usually up to 6 ls. wide, entire. *angustifolia,* Linn.
Leaflets usually up to 1 in. wide, often toothed. *tomentosa,* Linn.
Leaflets not as above.
Leaflets hairy.
Terminal panicles elongated, ample. *pyroides,* Burch.
Terminal panicles usually not much longer than the leaves.
*incana,* Mill.
Leaflets glabrous or nearly so, often shining.
Leaflets > 3 ls. wide.
Leaflets glaucous, under 1 in. long. *glauca,* Desf.
Leaflets green, usually 1 in. or more long.
Leaflets not undulate.
Leaflets with raised veins, margins revolute.
*scytophylla,* E. and Z.
Leaflets not prominently veined, margins flat.
Petioles not winged. *mucronata,* Thunb.
Petioles narrowly winged at the apex. *lucida,* Linn.
Leaflets undulate, denticulate or incised. *undulata,* Jacq.
Leaflets about 1 l. wide. *Dregeana,* Sond.

# NOVITATES AFRICANAE

Muraltia Muirii, Bol. f. (*Polygalaceae-Polygaleae* § *Eumuraltia*), *M. pilosae* affinis, sed foliis angustioribus, floribus minoribus, sepalis minus acutis, petalis truncatis, cornibus dimidio capsulae brevioribus differt.

Fruticulus, 14—20 cm. altus, basi valde ramosus, ramis virgatis, adscendentibus, plerumque simplicibus, dense pubescentibus vel pilosis; folia 5—13-fasciculata, saepissime internodia excedentia, suberecta vel squarrosa, linearia, ad mucronem pungentem attenuata, plana, supra glabra, infra praecipue per medium nervium prominentem pilosa, plus minusve dense ciliata, ad 0·85 cm. longa, 0·1 cm. lata; flores sessiles, 0·7 cm. longi, sepalis obtusis, ciliatis, marginibus delicatule hyalinis, minute mucronulatis, exterioribus obovatis, 0·2 cm. longis, interioribus oblongis, 0·15 cm. longis, petalis lateralibus linearibus, ad apicem parum dilatatis, truncatis, valde inconspicue emarginatis, 0·3 cm. longis; crista rubicunda, 0·4 cm. lata, segmentis obscure bilobis, carina 0·4 cm. longa, staminibus 7, filamentis fere ad apicem connatis, ovario dense piloso, inconspicue 4 tuberculato, 0·1 cm. longo, capsula valde obliqua, late oblonga, apice truncata, cornuta, leviter pilosa, 0·3 cm. longa, 0·2 cm. lata, cornibus 0·1 cm. longis.

Cape Province: South-Western Region; Mossel Bay Div., in the Langebergen, *J. Muir*, 1307.

Allied to *M. pilosa*, DC., but differs in having narrower leaves, smaller flowers, less acute sepals, truncate petals and horns less than half as long as the capsule. Plate XXIII B.

Aspalathus ciliatistyla, L. Bolus (*Leguminosae-Papilionaceae-Genisteae* § *Laterales*), affinis *A. Burchellianae,* sed foliis saepius 2—3-natis linearibus mucronatis, calyce petalisque extus glabris, legumine glabrescente differt.

Fruticulus adscendens vel decumbens, ad 42 cm. altus, e basi ramosus, ramis ad 0·3 cm. diam., virgatis foliosis, dense pubescentibus pilis brevibus crispulatis, partibus vetustioribus tuberculis lanigeris persistentibus notatis; folia e basi patente erecta vel subfalcate incurva, saepius 3- rarius 4-nata, linearia acuta mucronata (ut videtur carnosa, dorso convexa), glabra, ad 1 cm. longa, 0·15 cm. lata; flores 1—2-nati pedicellati, pedicellis sparse pubescentibus, 0·2—0·3 cm.

longis, medio 2 bracteolatis, bracteolis minutis; calyx oblique cyathiformis 10-costatus, 0·35 cm. longus, tubo apicem versus intus pubescente, sinubus late rotundatis, segmentis subaequilongis deltoideis acutissimis, ad 0·1 cm. longis; vexillum extus glabrum, 0·7 cm. longum, lamina subrhomboidea, basi intus incrassata denseque barbata, ungue subquadrato, vix 0·15 cm. longo; alae 0·5 cm. longae, lamina oblonga obtusa, ungue vix 0·15 cm. longo; carina obtusa saccata, 0·65 cm. longa, ungue 0·15 cm. longo; ovarium semi-ovatum pubescens 2-ovulatum, stylo genuflexo, ventraliter dense ciliato; legumen demum deflexum, subturgidum, oblique late ovatum, acuminatum, parce pubescens vel glabrescens, 0·9—1 cm. longum.

Cape Province: South-Western Region; Riversdale Div., hills round Albertinia, fl. Aug., *J. Muir*, 1076.

Allied to *A. Burchelliana*, Benth., but the leaves usually 2—3-nate linear mucronate, calyx and petals glabrous on the outside, and the legume glabrescent. Plate XX A.

Aspalathus quadrata, L. Bolus (§ *Sericea*), *A. intervallari* affinis, sed foliis oblongis, marginibus involutis, dorso glabrescentibus, calycis segmentis quadratis differt.

Fruticulus macer humilis, intertexte ramosus, ramis adscendentibus gracilibus sericeo-pubescentibus, abbreviatis vel elongatis, ad 28 cm. longis, saepius 0·1 cm. diam., vetustioribus rigidis, ad 0·5 cm. diam.; folia erecta vel patentia, 3-nata vel rarius fasciculata, oblonga obtusa vel subacuta, marginibus involutis, pagina superiore dense pilosa, inferiore sericea, deinde glabrescente, 0·2—0·5 cm. longa, 0·1—0·2 cm. lata (manu explicata); flores 1·1 cm. longi solitarii subsessiles, spicas foliatas laxiusculas ad 11 cm. longas formantes; bracteae foliaceae obovatae, vix 0·2 cm. longae, bracteolis angustioribus simillimae; calyx sericeo-pilosus 10-nervatus, 0·5—0·6 cm. longus, segmentis foliaceis quadratis vel subquadratis, marginibus leviter incurvis ciliatis, intus densissime pilosis, 0·15—0·2 cm. longis, sinubus rotundatis; vexillum cum alis carinaque extus sericeo-pilosum, lamina suborbiculari emarginata, 0·6 cm. longa, ungue gracili laminae aequilongo; alae lamina oblonga, apice obliqua obtusa, 0·6 cm. longa, ungue 0·4 cm. longo; carina saccata obtusissima, 0·9 cm. longa, lamina unguem parum excedens; ovarium oblique ovatum, dense cano-villosum, 2-ovulatum.

Cape Province: South-Western Region; Riversdale Div., Albertinia, fl. May, *J. Muir*, 1328.

Allied to *A. intervallaris*, Bolus, but differs in having oblong leaves with involute margins, dorsally glabrescent, and square, or nearly square, calyx segments. Plate XX C.

Aspalathus elongata, E. and Z., var. densa, L. Bolus, spicis densis, bracteis calycem fere aequantibus—ceteris typicis.

Cape Province: South-Western Region; Riversdale Div., Albertinia, fl. Dec., *J. Muir*, 1142. Clanwilliam Div., fl. Nov., *C. L. Leipoldt*, 401.

Differs from the typical form of *A. elongata*, E. and Z., in having the spikes very dense and the bracts nearly as long as the calyx. Plate XXI C.

Aspalathus Shawii, L. Bolus (§ *Laterales*), *A. eriophyllae* affinis, sed foliis laxe tomentosis, deinde glabrescentibus, calycis segmentis tubo duplo longioribus vel ultra, carina acute rostrata differt.

Fruticulus ramosus, ramis suberectis vel patenti-incurvis tomentosis foliosis, ad 19 cm. longis, 0·4 cm. diam.; folia 4—12-fasciculata, e tuberculo tomentoso patenti-incurva, apice saepe subrecurva, lineari-teretia pungenti-mucronata tomentosa, deinde glabrescentia, 0·5—1·7 cm. longa, circa 0·1 cm. lata; flores 1·5 cm. longi solitarii sessiles, spicas densas foliosas ad 6 cm. longas formantes; bracteolae deuntes; calyx 1·3 cm. longus, dense pilosus, segmentis e basi subulata longe acuminatis mucronatis, 0·9—1 cm. longis; vexilli lamina suborbicularis, extus pilosa, 1·3 cm. longa, ungue 0·3 cm. longo; alae lamina oblonga subfalcata, apice inaequaliter breviterque biloba, basi posteriore lobata, glabra, 1 cm. longa, ungue 0·4 cm. longo; carina acuta rostrata saccata glabra, lamina 0·9 cm. longa; ungue 0·5 cm. longo; ovarium lineari-lanceolatum pilosum 2-ovulatum; legumen ignotum.

Cape Province; South-Western Region; Clanwilliam Div., Kromme R. Valley, Cederbergen, alt. circa 2900 ft., fl. Sept., *J. Shaw* (Bolus, No. 5632). Near Pakhuis, in loose sandy soil, alt. 2000 ft., fl. Sept., *C. L. Leipoldt*, 723.

Allied to *A. eriophylla*, Walp., but the leaves are laxly tomentose, the calyx-segments twice as long as the tube or longer, and the carina acutely rostrate. Plate XX D.

Aspalathus remota, L. Bolus (§ *Laterales*), *A. incurvifoliae* affinis, sed foliis brevioribus, calycis segmentis tubum aequantibus, vexilli lamina apicem versus attenuata differt.

Fruticulus ramosus, ad 30 cm. altus; rami ascendentes, saepe incurvati, cinereo-tomentosi, dense foliosi, 0·1—0·4 cm. diam., vetustiores foliorum tuberculis lanatis, ad 0·2 cm. diam., conspicue notati; folia 7—15-fasciculata patenti-incurvata setacea semi-teretia mucronata, tenuiter pilosa vel glabra, 0·4—0·6 cm. longa, 0·05 cm. lata; flores solitarii subsessiles, in fasciculis foliorum fere absconditi, 0·6 cm. longi; bracteolae deuntes; calyx oblique cyathiformis, extus breviter pilosus, tubo 10-nervato, 0·15 cm. longo, segmentis lineari-subulatis acuminatis, tubo aequilongis, sinubus latis subtruncatis piloso-ciliatis; vexillum a ceteris petalis remotum, erectum, e dimidio laminae abrupte patens, apice vero sursum curvatum, lamina rhomboideo-orbiculari, apicem versus attenuata, intus basi pilosa, aliter glabra, 0·3 cm. longa, ungue oblongo, basi parum dilatato, 0·2 cm. longo; alae lamina oblonga obtusa subtorta, 0·25 cm. longa, ungue gracili, laminam aequante; carina obtusa, profunde saccata, vix 0·5 cm. longa, ungue lamina paullo breviore; ovarium breviter stipitatum, oblique ovatum villosum, 2-ovulatum; legumen ignotum.

Cape Province: South-Western Region; hills near Mier Kraal, between Elim and Cape Agulhas, fl. April, *R. Schlechter*, 10497. Riversdale Div., nr. Albertinia, fl. June, *J. Muir*, 1385, 943.

Allied to *A. incurvifolia*, Walp., but differs in having shorter leaves, calyx-segments as long as the tube, and the lamina of the vexillum narrowed towards the apex. Plate XXI B.

Indigofera antennulifera, L. Bolus (*Leguminosae-Papilionaceae-Indigofereae* § *Productae*), ab omnibus ceteris speciebus stipulis, foliolis, calycis segmentis in glandulam (ad modum *Rhynchosiae antennuliferae* sed minorem) desinentibus facile distinguitur.

Fruticulus gracillimus diffusus vel suberectus, omnibus partibus pilis laxe patentibus vel appressis, multicellularibus pellucidis dense vel tenuiter vestitus; rami teretes pallidi, ad 25 cm. longi, internodiis 1—1·5 cm. longis; stipulae erectae foliaceae, oblique lanceolato-ovatae acuminatae, cum glandula fere 0·1 cm. longa ad 0·8 cm. longae; folia ascendentia vel patentia, petiolo communi 0·6—1 cm. longo, foliolis 2-jugatis oppositis vel suboppositis, strigillosis, infimis 0·2 cm. supra basin positis, ad glandulas 0·2—0·3 cm. longas reductis, superioribus lineari-lanceolatis vel oblanceolatis, 0·6—1 cm. longis, terminali multo majore, saepe sursum flexo, obovato vel obovato-cuneato, ad 1·7 cm. longo; racemi 2-flori, foliis multo breviores, pedunculis capillaceis, saepius 0·2 cm. longis, bracteis bracteolisque non visis, pedicellis perbrevibus; calyx fere ad basin partitus, segmentis linearibus attenuatis, longe piloso-ciliatis, 0·4 cm. longis; vexillum calycem paullo excedens, lamina dorso tenuiter pilosa, 0·4 cm. longa lataque, ungue perbrevi; alae carinaque glabrae, vexillo aequilongae; ovarium pilosum; legumen oblongo-teres, parce pilosum, 2—3-seminatum, inter semines septuliferum, 0·6 cm. longum, 0·2 cm. diam.

Tropical Africa: Rhodesia; Victoria Falls, fl. April, *H. G. Flanagan*, 3089. Livingstone, in sand, alt. 3000 ft., fl. Aug., *F. A. Rogers*, 7206.

Easily distinguished from the other species of Indigofera by the antenna-like gland which terminates the stipules, leaflets and calyx-segments, very similar to that of *Rhynchosia antennulifera* but smaller.

Eriosema flemingioides, Baker, var. rhodesica, L. Bolus, a forma typica indumento cano, foliolis exstipellatis vel stipellis obscuris, pedicellis ad 0·5 cm. longis, alis carinaque supra medium pilosis, differt.

Tropical Africa: Rhodesia; near Salisbury, Glen Loorne, fl. April, *H. G. Flanagan*, 3105; Chishawasha, fl. Mar., *F. C. Kolbe*, 4306; *J. Ffolliott Darling* (Bolus Herb. No. 11186). Plate XXII A.

Pueraria ficifolia, L. Bolus, nov. comb. (*Rhynchosia ficifolia*, Benth., Harv. and Sond. *Flor. Cap.* II. 251).

Pueraria Rogersii, L. Bolus (*Leguminosae-Papilionaceae-Phaseoleae*), *P. ficifoliae*, L. Bolus arcte affinis, sed indumento sericeo tenuioreque et calycis segmentis brevioribus latioribusque differt.

Caulis subrobustus, ad 1 cm. diam., glabrescens vel tenuiter sericeus, internodiis 5—6 cm. longis; folia *P. ficifoliae*, petiolis 0·5 cm. longis, petiolulis 0·3—0·4 cm. longis, stipulis oblique ovato- vel lanceolato-oblongis, 1—1·1 cm. longis, stipellis lineari-lanceolatis, 0·6—1 cm. longis; pedunculi ad 11 cm. longi, racemis ad 21 cm. longis, floribus 3-natis; bracteae mox deciduae naviculariformes, supra medium longe attenuatae, 0·6—0·7 cm. longae; pedicelli ad 0·4 cm. longi; calycis tubus 0·3 cm. longus, segmentis oblongo-lanceolatis acutis subfalcatis, anteriore 0·6 cm. longo, ceteris 0·4 cm. longis, posterioribus per dimidium longitudinis connatis, sinubus subrotundatis; vexilli lamina cordato-reniformis glabra, 0·8 cm. longa, ungue sulcato, 0·3 cm. longo; alae lamina oblonga obtusa. saccata, 0·8 cm. longa, posteriore lobata, lobo patente lineari, 0·4 cm. longo, ungue gracili, 0·5 cm. longo; carina obtusissima, alis aequilonga; stamen vexillaris superne leviter adhaerens, basin versus liber incrassatusque; antherae uniformes; ovarium lineare villosum, 5-ovulatum, 0·7 cm. longum, stylo genuflexo glabro, 0·5 cm. longo, stigmate terminali subobliquo.

Transvaal: on the Selati Railway between Komati Poort and Letaba R., alt. 1000—2000 ft., fl. Nov., *F. A. Rogers*, 11806.

Very closely allied to *P. ficifolia*, L. Bolus, but with silky, finer and much less dense indument and with shorter and broader calyx segments. Plate XXII B.

Mesembrianthemum Mathewsii, L. Bolus (*Ficoideae-Mesembryeae*), fruticulosum glaberrimum, foliis alte connatis, turgide triquetris, glaucis politis, floribus solitariis 5-meris, petalis roseis, staminodiis staminibusque collectis.

Fruticulus ramulosus, ad 23 cm. altus, ramis patenti-adscendentibus compressis; folia saepe per dimidium longitudinis cohaerentia, obtusa vel subacuta, marginibus carinisque subpellucidis, 1—2 cm. longa, 0·9 cm. lata, 1 cm. diam.; flores breviter pedunculati, pedunculis sub calyce 2-bracteatis, in foliis inclusis; calycis tubus obconicus, segmentis inter se subaequilongis, oblongo-lanceolatis, 0·9 cm. longis; petala circa 4-seriata lineari-spathulata acuta, laete rosea, 1·5 cm. longa; staminodia erecta, in genere valida, fere rigida, a petalis bene distincta, anguste linearia, acuminata, superne lutescentia, 1·2 cm. longa; stamina 6—7-seriata, intima dense barbata, vix 0·2 cm., extima 0·9 cm. longa; glandulae parvae atrovirides; ovarium supra planum vel concavum, stylis 5-erectis subulatis, 0·2 cm. longis.

Cape Province: South-Western Region; between Muis Kraal and Ladismith, *N. S. Pillans*, 895. Karroo Region; Prince Albert Div., nr. Prince Albert, *J. W. Mathews* (National Botanic Gardens, No. $\frac{4055}{14}$).

A copiously branched shrublet with deeply connate, turgidly triquetrous, pale glaucous polished leaves, solitary 5-merous flowers with rose-pink petals and collected staminodes and stamens.

Described from living specimens which flowered freely in Mr N. S. Pillans' garden, Rosebank, in 1912, and in the National Botanic Gardens, Mar. 1915.

Mesembrianthemum hesperanthum, L. Bolus (§ *Spinulifera*), caule erecto graciliore, floribus odoratis vespertinis, petalis carneis, nectariis tubiformibus, stylis elongatis, distinguitur.

Fruticulus papillosus, ad 20 cm. altus; rami ramulique ascendentes vel patentes, saepius rubidi, internodiis 1—3 cm. longis; folia patentia, demum reflexa, basi connata, linearia semiteretia subacuta, supra satis conspicue canaliculata, minute papillosa, 2—3 cm. longa, 0·2—0·3 cm. lata; flores 3-nati vel abortione 1—2-nati, ad 2·5 cm. diam.; calyx subturbinatus, obtuse 5-angulatus, angulis nectaria formantibus, segmentis 5, inter se inaequalibus, duo lanceolatis, 0·6 cm. longis, ceteris brevioribus, late membranaceo-marginatis; petala 3—4-seriata lineari-spathulata subacuta, inferne alba, ultra medium carnea, 1·2 cm. longa, apice 0·1 cm. lata; stamina circa 5-seriata erecta, demum exteriora patula (ad modum sectionis *Splendentia*), filamentis ebarbatis; nectaria sepalis opposita; ovarium supra conicum, leviter 5-angulatum, stylis 5-erectis filiformibus, 0·8 cm. longis.

Kalahari Region: Bechuanaland; Gaberones, *F. A. Rogers* (National Botanic Gardens, No. $\frac{769}{13}$).

Distinguished by the erect rather slender stem, sweet-scented flowers opening after sunset with pale pink petals, tubular nectaries, and elongate styles. Probably closely allied to *M. decussatum*, Thunb.

Described from living material which flowered in the National Botanic Gardens, Kirstenbosch, Dec.—Jan., 1914—15.

Mesembrianthemum ebracteatum, L. Bolus, perenne suberectum ramosum, foliis basi connatis semiteretibus, minute papillosis, pedunculis ebracteatis, floribus 3-natis 4-meris, petalis purpureis.

Herba subrigida glabra, ad 15 cm. alta; rami teretes rubescentes; folia patentia subacuta, 1·8—2·6 cm. longa, 0·4—0·5 cm. diam.; pedunculi subcompressi, 0·5—1·5 cm. longi; calyx turbinatus, segmentis valde inaequalibus, duo foliaceis, 1—2 cm. longis; petala pluriseriata, anguste linearia, acuta, 1·6—1·8 cm. longa; stamina plurima, in stylos incurvata; ovarium convexum, 0·4 cm. diam.; stylis erecto-patentibus setaceo-acuminatis, 0·3 cm. longis.

Locality unknown.

A perennial, rather rigid, branched herb, with the leaves connate at the base, semi-terete, minutely papillose, all the peduncles ebracteate, the flowers 3-nate 4-merous and the petals purple.

Described from a living plant which flowered in Mr N. S. Pillans' garden from Oct.—Dec., 1908. The larger measurements given were taken from the plant as it was in Oct., the smaller as it was during the summer months.

Relhania Steyniae, L. Bolus (*Compositae-Inuloideae*), foliis erectis vel erecto-patentibus, apice strictis, dense imbricatis, subcomplicatis, dorso carinatis, capitulis 4—5 aggregatis sessilibus, facile distinguitur.

Fruticulus ad 15 cm. altus, ramis adscendentibus glabris vel junioribus araneosis, dense foliosis; folia sessilia quadriseriata, saepissime arcte adpressa, lineari-lanceolata acuminata pungenti-mucronata subaraneosa, mox glabrescentia, 0·8—1·8 cm. longa, 0·2—0·4 cm. lata; involucrum oblongum, 0·8—1 cm. longum, apice 0·5 cm. diam., squamis circa 6-seriatis, ovatis vel oblongis obtusis scariosis brunneis, marginibus hyalinis; receptaculum supra planum, 0·25 cm. diam.; paleae lineares, 0·7 cm. longae; disci corolla cylindrici, supra medium parum ampliata, 0·5 cm. longa, segmentis acutis, vix 0·1 cm. longis; ovarium glabrum, 0·2 cm. longum; pappus e squamis pluribus hyalinis fere liberis, 0·75 mm. longis compositus.

Cape Province: South-Western Region; Riversdale Div., Stille Bay, fl. July, *Mrs J. G. Steyn* (*E. E. Galpin*, 5438); fl. Jan., *J. Muir*, 1865.

Easily distinguished by the erect or erect-spreading leaves, straight at the apex, densely imbricate, rather complicate, and keeled dorsally, and the sessile heads, 4—5 in a cluster. Plate XXIII C.

Relhania Patersoniae, L. Bolus, *R. centauroidi* (e descr.) affinis, sed foliis oppositis, capitulis obconicis majoribusque, involucri squamis omnibus membranaceo-marginatis differt.

Fruticulus erectus ramosus, 24 cm. altus; rami erecti vel adscendentes glabri, ad capitula foliosi, 0·2—0·3 cm. diam.; folia erecto-patentia, apice incurva, opposita sessilia subamplexicaulia lanceolato-linearia, sensim attenuata mucronata, dorso carinata glabra, supra arcte cano-tomentosa, subrigida, 0·4—0·7 cm. longa, vix 0·2 cm. lata; capitula solitaria obconica, involucro 2 cm. longo, apice 1·5 cm. diam., squamis 6-seriatis adpressis scariosis brunneis membranaceo-marginatis, exterioribus ovatis, 0·2—0·7 cm. longis, intimis linearibus acutis, praecedentes multo excedentibus 1·7 cm. longis; paleae acuminatae, 0·9 cm. longae; flores radii 14, corolla apice 3-denticulata aurea, 2 cm. longa, ovario subtriquetro, dense piloso, 0·3 cm. longo; disci corolla apicem versus sensim parum ampliata, infra medium atro-brunnea, superne aurea, 0·7 cm. longa, segmentis acutis, vix 0·1 cm. longis; antherae 0·4 cm. longae; ovarium obscure 3-alatum glabrum, 0·25 cm. longum; pappi squamae fere liberae angustae setaceo-acuminatae, 0·75 cm. longae.

Cape Province: South-Western Region; Uniondale Road, fl. Oct., *Florence Paterson*, 3060.

Probably allied to *R. centauroides*, DC., but differs in having opposite leaves, obconic larger heads, and all the involucral scales with membranous margins. Plate XXIII D.

Senecio Muirii, L. Bolus (*Compositae-Senecionideae* § *Kleinia*), foliis oblongo-obovatis subintegris vel junioribus utrinque 2—3-denticulatis, capitulis in laxam paniculam longe pedunculatam dispositis, et corollis dilute stramineis distinguitur.

Herba glabra erecta, simplex vel parce ramosa, ad 37 cm. alta; caulis laevis, 11 cm. altus, 0·6 cm. diam., internodiis 0·4 cm. longis; folia carnosa glauco-viridia laevissima, saepe erecta, alterna, basi in petiolum perbrevem attenuata, apice rotundata vel subacuta, apiculata, supra ± concava, marginibus recurvis, palmate 5-nervata, ad 5 cm. longa, 2·2 cm. lata; pedunculus teres, inferne nudus, cum panicula 22 cm. longus, e medio ramosus, ramis ultimis 2—3 cm. longis, apice 2—3 squamis onustis; capitula homogama oblonga, 1 cm. longa, 0·5 cm. diam.; involucri squamae 8, lineares, apice deltoidea, membranaceo-marginatae, 0·7 cm. longae; corolla e medio parum ampliata, dilute straminea, 0·7 cm. longa, segmentis acutis, 0·15 cm. longis; styli rami truncati; achaenia striata, striis setulosis, 0·4 cm. longa.

Cape Province: South-Western Region; Riversdale Div.; cliffs, Gouritz River, *J. Muir*.

Distinguished by the oblong-obovate almost entire leaves, or the younger ones 2—3-denticulate on each side, the capitula disposed in a lax long-pedunculate panicle, and the corolla being a pale straw colour.

Described from living material which flowered in the National Botanic Gardens, Kirstenbosch, April, 1915. Plate XXIII E.

Wahlenbergia Guthriei, L. Bolus (*Campanulaceae-Campanuleae*), *W. robustae* (e descr.) affinis, sed foliis sessilibus, basi ampliatis, saepius lobatis, corollae tubo segmentis 2—3-plo longiore, et calycis segmentis capsulae valvas interdum multo excedentibus differt.

Fruticulus ramosus, ramis suberectis vel patentibus virgatis subangulatis, pilis patentibus vel crispulatis brevissimisque pubescentibus, demum glabris, rubido-brunneis, internodiis saepius 0·4 cm. longis; folia fasciculata erecta, vel recurva, lanceolata vel linearia, acuta, marginibus revolutis vel incrassatis, saepius basin versus rigide ciliata, aliter glabra, primaria basi utrinque lobata, lobis obscuris vel bene evolutis, sursum falcato-curvatis, 0·5—1 cm. longa, basi ad 0·2 cm. lata; flores solitarii, in fasciculis subsessilibus; calycis tubus subglobosus, 0·15 cm. longus, segmentis erectis lineari-lanceolatis acutis ciliatis, 0·3—0·4 cm. longis; corollae tubus cylindricus, 1—1·6 cm. longus, 0·1 cm. diam., apice parum dilatatus, segmentis patentibus lanceolatis, 0·5—0·6 cm. longis; stamina corollae tubo parum breviora, filamentis basi non dilatatis, antheris linearibus 0·25 cm. longis; capsula trilocularis, 0·2 cm. diam., valvis brevibus obtusis.

Cape Province: South-Western Region; Mossel Bay Div., upper slopes of Langebergen, fl. April, *J. Muir,* 1330. George Div., near George, alt. 600 ft., fl. Jan., *F. Guthrie,* 4340; Montagu Pass, alt. 2100 ft., fl. Jan., *H. Bolus,* 8666.

Allied to *W. robusta,* Sond., according to the description, but differs in having sessile leaves widened at the base and usually lobed, the corolla-tube 2—3 times as long as the segments, and the calyx-segments sometimes much longer than the valves of the capsule. The corolla is a deep blue and very fugitive (fide Dr J. Muir).

Statice capensis, L. Bolus (*Plumbagineae-Staticeae*). Ceteris speciebus capensibus facile distinguitur ramis per totam longitudinem foliosis, et spicis simplicibus paucifloris.

Herba rigida humilis, e basi ramosa, ramis ad flores foliosis, ad 9 cm. longis, 0·2 cm. diam.; folia erecta vel suberecta obovato-spathulata mucronata glauca, ad 1·8 cm. longa, 0·3—0·4 cm. lata; flores erecti, in spicas flexuosas equilaterales dispositi, speciosi; bracteae late oblongae, cum bracteolis conspicue membranaceo-marginatae, 0·4—0·5 cm. longae; bracteolae superiores late obovatae, sine flore altero in axillo, 1·2 cm. longae; calyx 1·9 cm. longus, tubo infra medium patenti-piloso, limbo roseo purpureo-vittato, 1·7 cm. diam., 10-lobato, lobis subaequilongis rotundatis; petala libera spathulata purpurea, 1·5 cm. longa; antherae supra medium dorsifixae, 0·3 cm. longae; ovarium acute 5-angulatum, 0·3 cm. longum, stylis liberis.

Cape Province: South-Western Region; nr. Hopefield, fl. Dec., *R. Pattison* (Bolus Herb., No. 13254).

Easily distinguished from all the other Cape species by the branches being leafy throughout, and by the unbranched few-flowered spikes. The calyx is very like that of *S. rosea*, Sm. Plate XXIII A.

Stapelia Rogersii, L. Bolus (*Asclepiadaceae-Stapelieae*), caulibus glabris, corollae disco dense papillato, segmentis replicatis, basin versus pilis pellucidis apice globose inflatis, coronae squamis interioribus gracillimis elongatis bene distinguitur.

Caules ascendentes vel erecti, 4-angulati, inter angulos rotundatos sulcati, glabri, dilute virides, ad 10 cm. alti, sine dentibus 0·8 cm. diam., dentibus suberectis vel patentibus subulatis acutissime acuminatis, 1—1·8 cm. longis, basi ad 0·5 cm. diam.; flores in 3—4 fasciculos per caulem dispositi, saepius duo in fasciculo simul aperti, pedicellati, pedicellis glabris 1·3—1·5 cm. longis, 0·15 cm. diam.; sepala lanceolata acuminata glabra, 0·3—0·4 cm. longa; corolla pallida subflavida, extensa 3—3·5 cm. diam., disco 0·5 cm. diam., papillis brevibus globosis pellucidis dense vestito, segmentis ascendentibus incurvis, rarius patentibus, linearibus acutis, supra medium replicatis, superne minutissime papillatis, dorso glabris, infra medium ad basin pilis introflexis multicellularibus pellucidis, apice globose inflatis, 0·1 cm. longis ciliatis; coronae squamae exteriores e basi patente sursum curvatae, oblongae, supra canaliculatae, apice 3-dentatae, vix 0·3 cm. longae, interiores erectae, fere ad basin 2-partitae, segmento dorsali filiformi integro, 0·5 cm. longo, segmento interiore ad antheram 3-partito, partibus simillimis filiformibus attenuatis, apice tortis intertextisque, 0·8 cm. longis.

Tropical Africa: Bechuanaland Protectorate, Mahalapye, fl. Mar., *F. A. Rogers*, 6298. Flowered in National Botanic Gardens, Mar. 1915. No. $\frac{651}{14}$.

A very distinct species having glabrous stems, corolla-disk densely papillose, segments replicate, ciliate towards the base with pellucid hairs globosely swollen at the apex, and the inner coronal scales very slender and elongated.

Duvalia transvaalensis, Schltr., var. parviflora, L. Bolus, nov. var., corollae annulo minute scaberulo, lobis eciliatis maculatis, 0·8 cm. longis.

Transvaal: Kalahari Region; in shrubberies on farm "Seringa," nr. Naboomspruit, alt. 3750 ft., *E, E. Galpin*, 8467. Flowered in Garden at Queenstown, March, 1914.

Described from living material and flowers preserved in formalin by Mr Galpin who notes that "it does not seem to open more than one flower at a time, but when it opens there are usually one or two very small flower buds just forming at the base of the peduncle which subsequently develop. The open flower lies flat on the ground with the calyx buried in the sand."

The annulus of the corolla is minutely but densely scaberulous. The segments are 0·8 cm. long, blotched with reddish brown, and there is no trace of ciliation, nor were any hairs to be found in the formalin.

Disa Begleyi, L. Bolus (*Orchideae-Ophrydeae*). *D. bivalvatae*, Dur. and Schinz, affinis, sed floribus minoribus carneis, sepalo impari valde reflexo, haud compresso, petala circuitu suborbicularia, anthera reflexa differt.

Herba glabra gracilis, 7—12 cm. alta; caulis substrictus, per totam longitudinem foliatus; folia erecta vel adscendentia, basi internodia amplectentia obtegentiaque, lanceolata, longe attenuata, 2—4 cm. longa, suprema lanceolato-ovata acuta; racemi densi subcorymbosi, 2—5 cm. diametro, 6—12-fl., floribus adscendentibus; bracteae herbaceae, oblongo-ovatae vel ovatae acutae, ovario breviores, 0·5—1·4 cm. longae; pedicelli ad 0·6 cm. longi; sepala lateralia patula, apice vel parum supra basin recurva, oblique elliptico-oblonga, 0·7—0·9 cm. longa, impari reflexo cucullato, apice rotundato, haud compresso, ecalcarato, 0·7—0·8 cm. longo; petala resupinata, apice inflexa, circuitu suborbicularia, brevissime unguiculata, lamina anteriore rotundata, posteriore obliqua, 0·5 cm. longa; labellum patens lineare, supra medium paullo ampliatum, acutum, petalis aequilongum; rostelli brachia divergentia, lobo intermedio resupinato; anthera reflexa.

Cape Province: South-Western Region; Stellenbosch Div., plateau on the Hottentotsholland Mts. south of Sneeuwkop, 4000—4500 ft., fl. Jan., *H. V. Begley* (Bolus Herb. No. 13896).

Closely allied to *D. bivalvata*, Dur. and Schinz, but differs in having smaller pink flowers, the odd sepal strongly reflexed and not laterally compressed, the petals being suborbicular in outline, and the anther reflexed.

Acidanthera Muirii, L. Bolus (*Irideae-Ixieae*), ad *A. capensem* accedit sed cormo valde dissimili, foliis paucioribus tenuioribusque, perianthii tubo breviore, styli ramis elongatis, spiraliter tortis, distinguitur.

Glabra, 18—34 cm. alta; cormus ovoideus obliquus, in collem brevem attenuatus, basi planus, tunicis squamiformibus, anguste alatis, sature brunneis, ad 1 cm. longus, 0·8 cm. diam.; caulis gracilis herbaceus, 5—6-foliatus, apice 1—2-florus; folia subflaccida ascendentia plana, anguste linearia, nerviis inconspicuis, inferiora 2—4, 5—16 cm. longa, superiora 2—3, sensim breviora; spathae valvae omnino herbaceae vel superne rubescentes, tenuissime crebro nervatae, 2—3 cm. longae; perianthii tubus leviter curvatus, apicem versus ampliatus, 2—2·6 cm. longus, basi 0·15 cm., apice 0·5 cm. diam.; segmentis radiatim patentibus, inter se subaequalibus, oblongo-lanceolatis, dilute carneis roseo-lineatis, exterioribus acutis apiculatis, interioribus obtusis, 2—3 cm. longis, 0·7—0·9 cm. latis; antherae dimidium segmenti vel ultra attingentes, lineares, 0·9 cm. longae; ovarium subcylindricum, 1·2 cm. longum, stylo tereti, ramis elongatis, altero latere dense papillatis, distinctis vel spiraliter intertextis, partibus papillatis extus; capsula cylindrica, basi apiceque leviter attenuata, 2·2 cm. longa, 0·4 cm. diam., seminibus alatis.

Cape Province: Riversdale Div.; Tygersfontein, beyond Schuldpadgat, Oct., *J. Muir*, 1087.

Approaches *A. capensis*, Benth., but the corm is very different, the leaves fewer and thinner in texture, perianth tube shorter and the style branches elongate and spirally twisted.

The following notes were communicated by the collector, Dr J. Muir—"It grows in the shade of *Relhania genistaefolia* and *Elytropappus rhinocerotis*, the sunlight filtering through. When fresh the flower makes a perfectly regular (actinomorphic) star. The tube is curved and dilated in the extreme upper part. The perianth limb is not quite set at a right angle but nearly so. In flowers fading *in the veld* it is quite at a right angle, i.e. it seems to fall further back. The stamens are not equilateral when fresh, although more or less tangled up with the twisted style-branches when dried. The stamens are above the style-branches and curved."

Gladiolus leptosiphon, Bol. f. (*Irideae-Ixieae*). *G. Muirii*, L. Bolus affinis, sed foliis angustioribus, perianthio cremeo, tubo graciliore, longiore, strictiore, segmentis angustioribus differt.

Cormus ovatus, apicem versus attenuatus, tunicis fibrosis; caulis erectus, subteres, gracilis, glaber, 28—38·5 cm. altus (sine spica), 0·2 cm. diam. medio parte; folia basalia 3, erecta, stricta, plana, glabra, angustissime linearia, marginibus subdilatatis, medio nervio prominente, 20—51 cm. longa, 0·1—0·13 cm. lata, folia caulina 2, 2·5—18·5 cm. longa; spica aequilateralis, simplex vel e bractea infima ramosa, axi stricto, terete, glabro, 4—15·5 cm. longa, 3—7 fl., floribus erectis; spathae valva exterior lanceolata vel lin.-lanceolata, acuminata vel acuta, 2—3·2 cm. longa, 0·25 cm. lata, valva interior brevior; perianthii tubus erectus, strictus, gracillimus, nisi apicem versus genuflexus, infundibuliformis, 2·9—3·6 cm. longus, 0·1—0·075 cm. diam., segmentis cremeis, supremo cucullato, e medio erecto, late ovato-lanceolato, obtuso vel subacuto, 3 cm. longo, 0·9 cm. lato, lateralibus patulis, lanceolatis, obtusis vel subacutis, inferioribus breviter coalitis, supremo aequilongis sed subangustioribus, inferioribus recurvis, per tertiam coalitis, linearibus, obtusis, obscure emarginatis, apicem supra purpureo-vittatis, 0·35 cm. latis, exteriore lateralibus aequilongo, interioribus 2·3 cm. longis, stamina dimidium segmentorum attingentia, antheris linearibus, 0·57 cm. longis.

Cape Province: South-Western Region; exact locality uncertain. Exhibited at the Cape Town Wild Flower Show, October, 1914, among plants from the Riversdale and Oudtshoorn Divisions.

Allied to *G. Muirii*, L. Bolus, but differs in the narrower leaves, the cream-coloured perianth, the more slender, longer and straighter tube and the narrower segments.

# EXPLANATION OF PLATES

## PLATES XVIII, XIX

### Legumes of South African Acaciae.

Fig. 1, A. giraffae, Willd.; 2, 7, A. detinens, Burch.; 3, A. ataxacantha, DC.; 4, A. Burkei, Benth.; 5, A. pennata, Willd.; 6, A. caffra, Willd.; 8, A. Kraussiana, Meisn.; 9, A. glandulifera, Schinz; 10, A. Karroo, Hayne; 11, A. caffra, Willd., var. tomentosa, Glover; 12, A. albida, Delile; 13, A. clavigera, E. Mey.; 14, A. pallens, Engl.; 15, A. Benthamii, Rochbr.; 16, A. spirocarpoides, Engl.; 17, A. Gerrardi, Benth.; 18, A. natalitia, E. Mey.; 19, 20, A. hebeclada, DC.; 21, A. hirtella, E. Mey.; 22, A. robusta, Burch.; 23, A. lasiopetala, Oliv.; 24, A. haematoxylon, Willd.—nat. size.

## PLATE XX

### A. Aspalathus ciliatistyla, L. Bolus. B. Aspalathus acanthes, E. and Z. C. Aspalathus quadrata, L. Bolus. D. Aspalathus Shawii, L. Bolus.

A. Fig. 1, sketch of branchlet, nat. size; 2, leaf, dorsal view × 2; 3, flower; 4, calyx, with pedicel; 5, ditto, laid open, inner view— × 4; 6, vexillum, inner view; 7, ala; 8, carina— × 3; 9, androecium × 7; 10, gynaeceum × 4; 11, ovary × 5; 12, legume × 3.

B. Fig. 1, sketch of branchlet, nat. size; 2, flower; 3, calyx, with pedicel × 2; 4, ditto, laid open; 5, vexillum, dorsal view; 6, ala; 7, carina— × 2; 8, androecium × 3; 9, gynaeceum × 2; 10, ovary × 3.

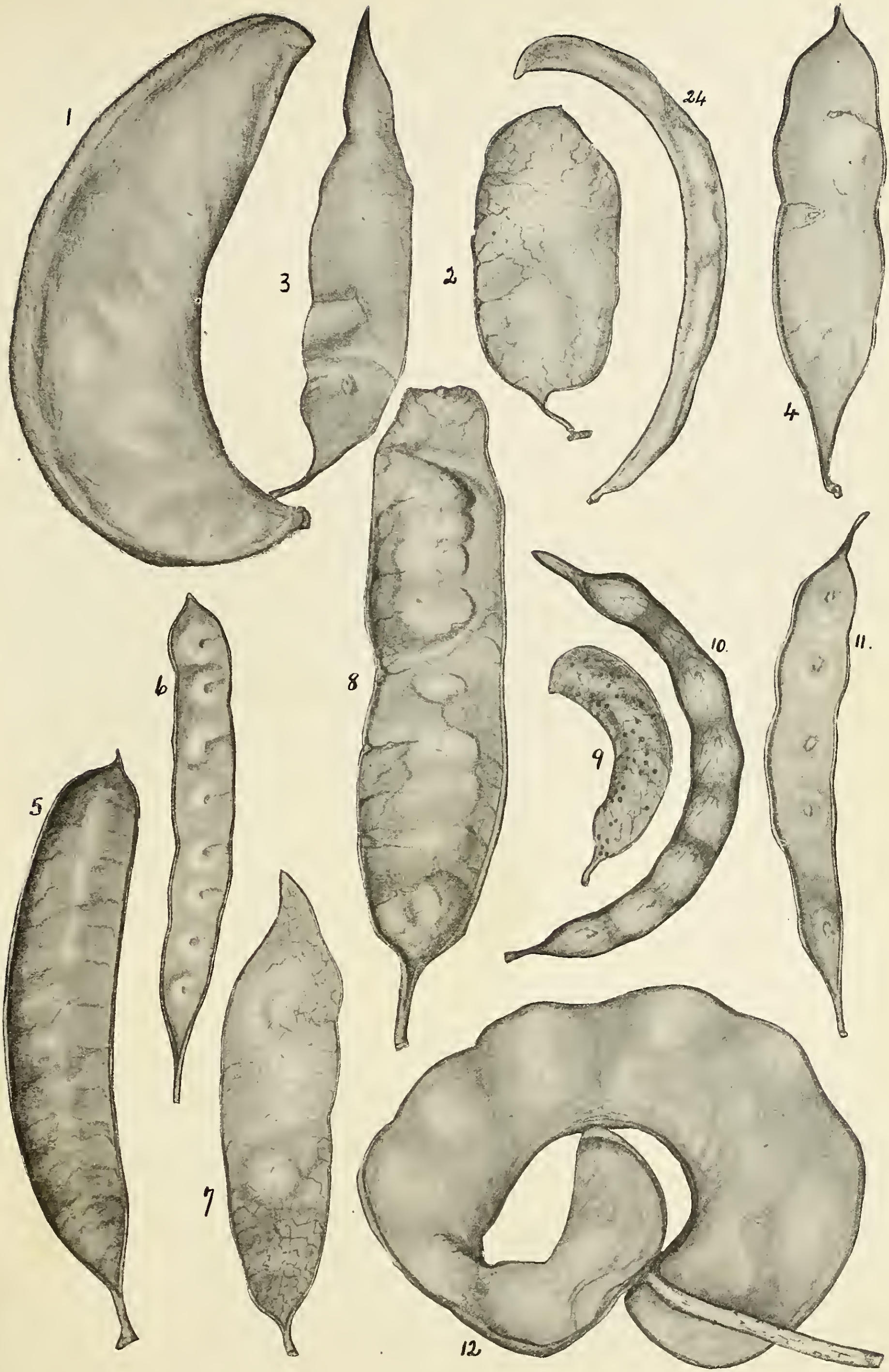
C. Fig. 1, sketch of branchlet, nat. size; 2, node, shewing dorsal view of leaves × 4; 3, flower, calyx and pedicel; 5, ditto, laid open, inner view; 6, vexillum, ditto; 7, ala, outer view; 8, carina, ditto— × 2; 9, androecium × 3; 10, gynaeceum × 2; 11, ovary × 4.

D. Fig. 1, sketch of branchlet, nat. size; 2, flower; 3, calyx and pedicel— × 2; 4, calyx, laid open, inner view; 5, vexillum—nat. size; 6, ala; 7, carina; 8, androecium; 9, gynaeceum— × 2; 10, ovary × 3.

## PLATE XXI

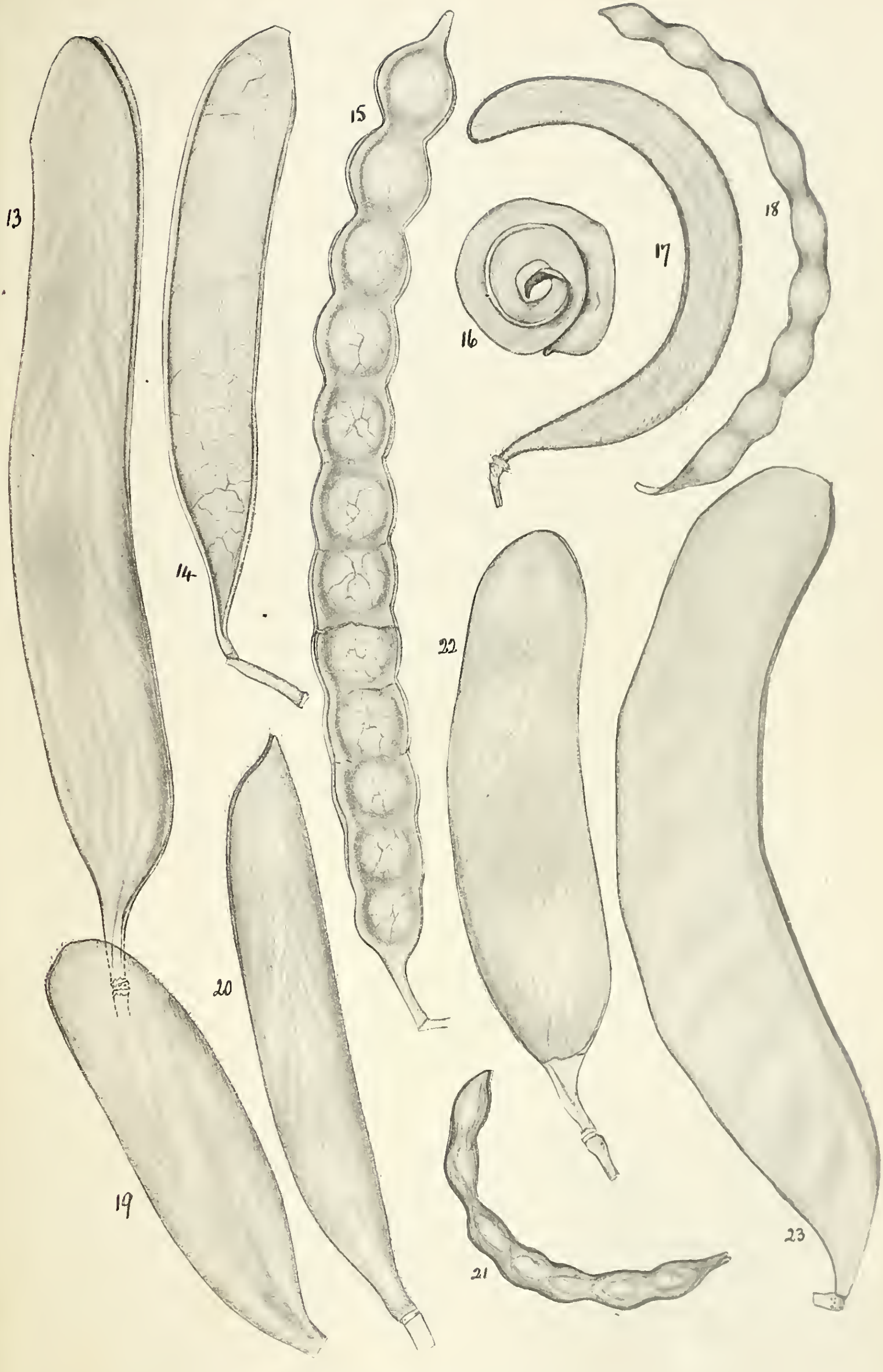
### A. Aspalathus hirta, E. Mey. B. Aspalathus remota, L. Bolus. C. Aspalathus elongata, E. and Z., var. densa, L. Bolus.

A. Fig. 1, sketch of branchlet; 2, flower; 3, calyx and pedicel; 4, ditto, laid open, inner view; 5, vexillum; 6, ala; 7, carina; 8, androecium; 9, gynaeceum—nat. size; 10, stigma; 11, ovary—enlarged.



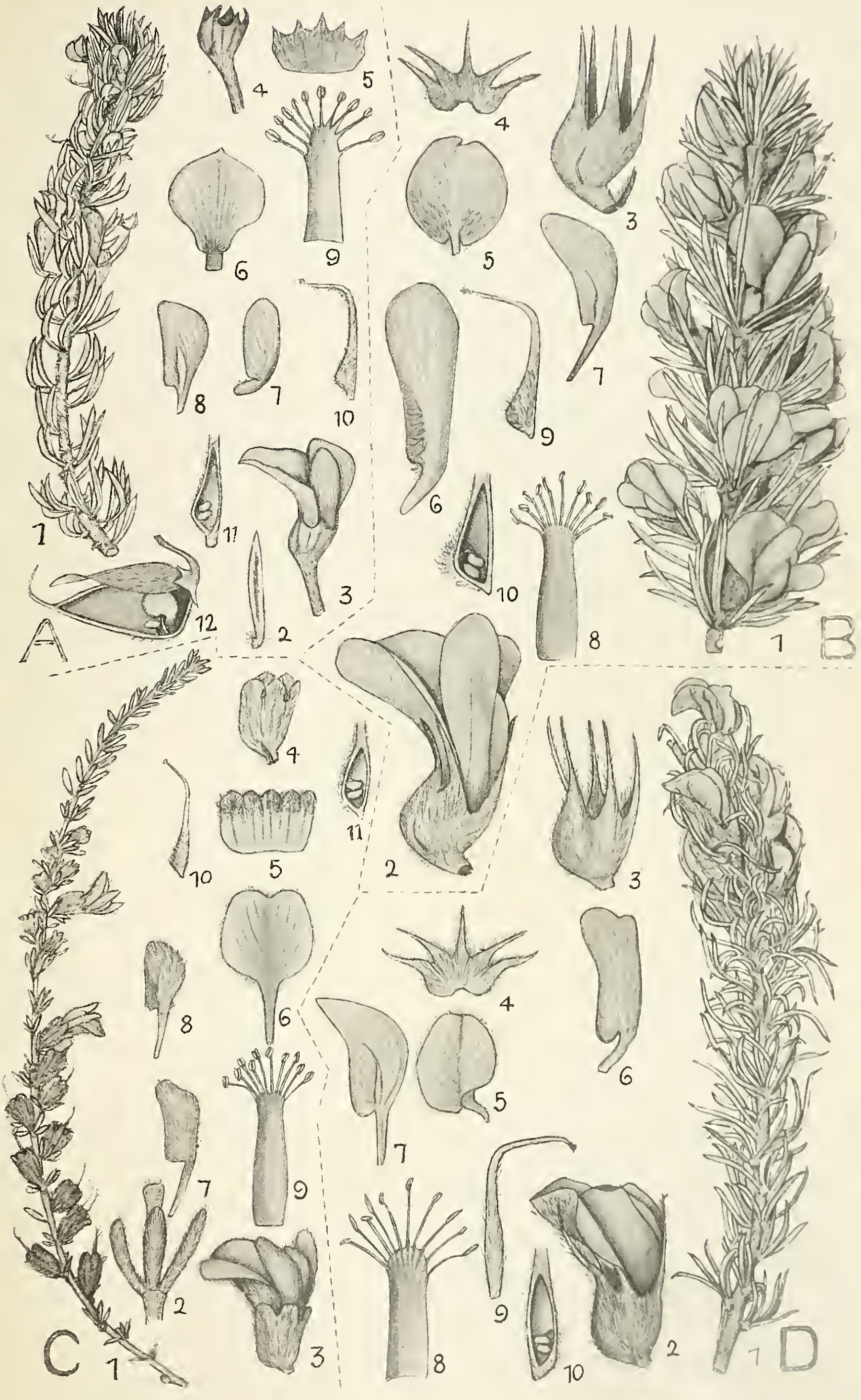
*A. C. Dawson, del. e sicco*

Legumes of South African Acaciae



*A. C. Dawson, del. e sicco*

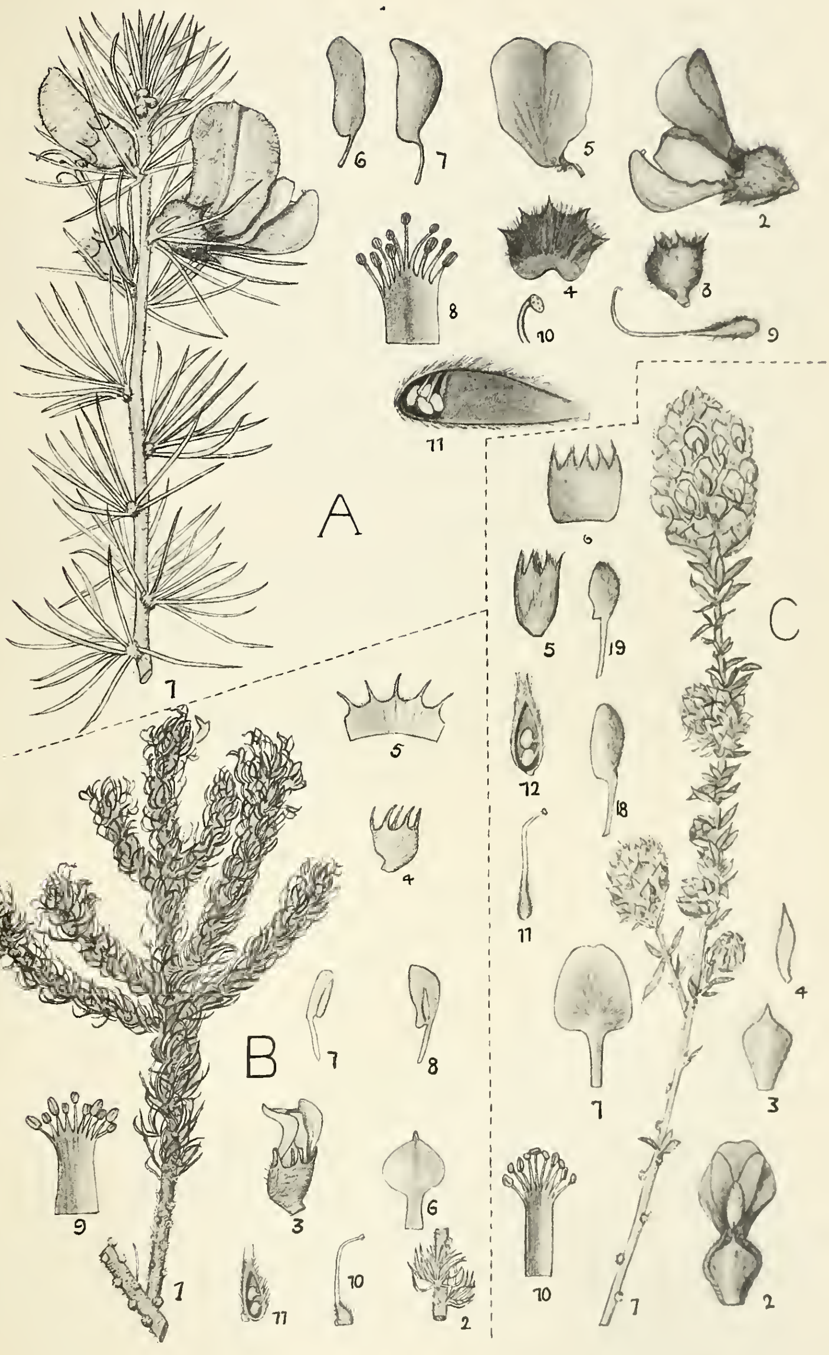
Legumes of South African Acaciae



*A. C. Dawson, del. e sicco*

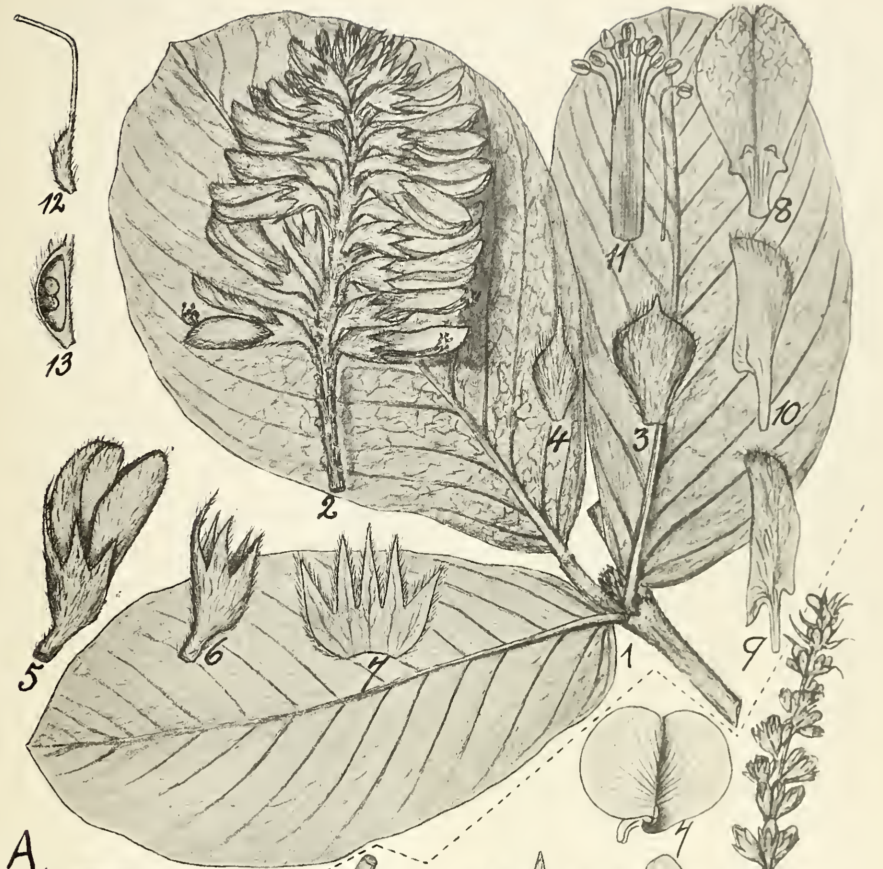
A. Aspalathus ciliatistyla, L. Bolus
C. Aspalathus quadrata, L. Bolus

B. Aspalathus acanthes, E. and Z.
D. Aspalathus Shawii, L. Bolus



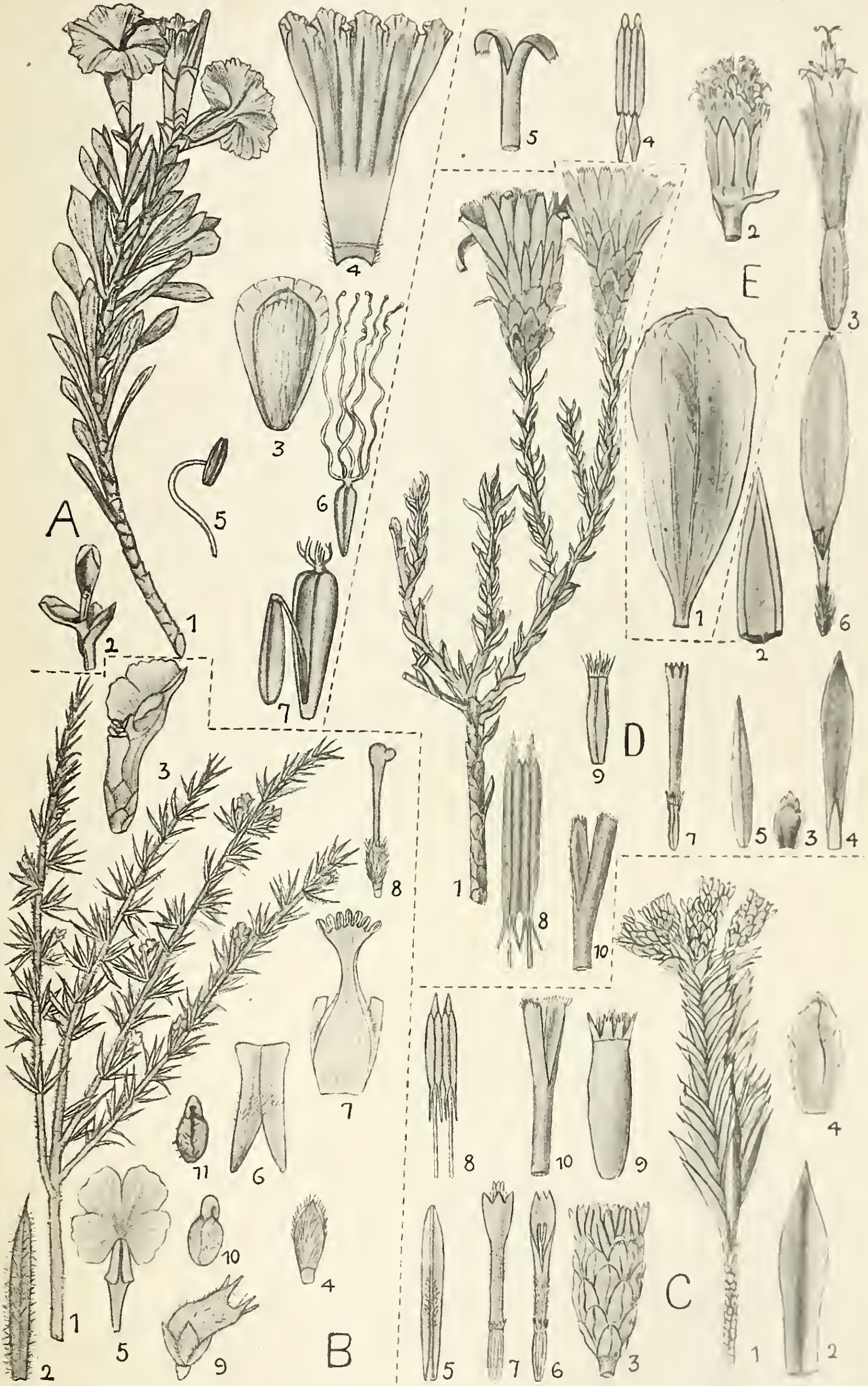
*A. C. Dawson, del. e sicco*

A. Aspalathus hirta, E. Mey.
B. Aspalathus remota, L. Bolus
C. Aspalathus elongata, E. & Z., var. densa, L. Bolus



*A. C. Dawson, del. e sicco*

A. Eriosema flemingioides, Baker, var. rhodesica, L. Bolus
B. Pueraria Rogersii, L. Bolus



*A. C. Dawson*
*M. W. Glover* } *del. e sicco*

A. Statice capensis, L. Bolus
B. Muraltia Muirii, Bolus f.
C. Relhania Steyniae, L. Bolus
D. Relhania Patersoniae, L. Bolus
E. Senecio Muirii, L. Bolus

B. Fig. 1, sketch of branch; 2, portion of branch—nat. size; 3, flower; 4, calyx with pedicel; 5, ditto, laid open, inner view; 6, vexillum, ditto; 7, ala; 8, carina—× 3; 9, androecium × 5; 10, gynaeceum × 3; 11, ovary × 6.

C. Fig. 1, sketch of branch; 2, flower; 3, bract; 4, bracteole; 5, calyx and pedicel; 6, ditto, laid open, inner view; 7, vexillum, outer view; 8, ala, ditto; 9, carina, ditto; 10, androecium; 11, gynaeceum— × 3; 12, ovary × 6.

## PLATE XXII

### A. ERIOSEMA FLEMINGIOIDES, BAKER, VAR. RHODESICA, L. BOLUS.
### B. PUERARIA ROGERSII, L. BOLUS.

A. Fig. 1, portion of branch, shewing lower surface of leaf; 2, raceme—nat. size; 3, 4, bracts; 5, flower; 6, calyx; 7, ditto, laid open, inner view; 8, vexillum, inner view; 9, ala, outer view; 10, carina; 11, androecium; 12, gynaeceum—all × 2; 13, ovary × 4.

B. Fig. 1, portion of branch; 2, upper part of inflorescence—nat. size; 3, bract × 3; 4, flower; 5, calyx and pedicel; 6, ditto, laid open; 7, vexillum; 8, ala; 9, carina; 10, androecium; 11, gynaeceum— × 2; 12, ovary × 6.

## PLATE XXIII

### A. STATICE CAPENSIS, L. BOLUS. B. MURALTIA MUIRII, BOLUS f. C. RELHANIA STEYNIAE, L. BOLUS. D. RELHANIA PATERSONIAE, L. BOLUS. E. SENECIO (§ KLEINIA) MUIRII, L. BOLUS.

A. Fig. 1, sketch of branch, nat. size; 2, portion of flowering axis; 3, upper bracteole; 4, calyx; 5, stamen— × 2; 6, gynaeceum × 3; 7, ovary × 8.

B. Fig. 1, sketch of branch, nat. size; 2, leaf; 3, flower— × 4; 4, lateral sepal × 7; 5, keel × 4; 6, lateral petals × 7; 7, staminal tube—upper portion of petals cut off × 8; 8, gynaeceum × 7; 9, capsule; 10, 11, seed— × 4.

C. Fig. 1, sketch of branch, nat. size; 2, leaf, upper surface; 3, head— × 2; 4, involucral scale; 5, palea; 6, ray floret—undeveloped; 7, disk floret— × 4; 8, anthers × 8; 9, achene and pappus × 12; 10, style-branches × 16.

D. Fig. 1, sketch of branch, nat. size; 2, leaf, upper surface, flattened × 4; 3, 4, involucral scales × 2; 5, palea × 3; 6, ray floret × 2; 7, disk floret × 3; 8, anthers × 8; 9, achene and pappus × 6; 10, style-branches × 12.

E. Fig. 1, leaf, lower surface, nat. size; 2, head × 2; 3, floret × 4; 4, anthers × 8; 5, style-branches × 8.

## PLATES XXIV, XXV, XXVI

### GNETUM.

(See pp. 171, 172.)

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